

## **NAVAL SHIPS' TECHNICAL MANUAL**

### **CHAPTER 670**

# **STOWAGE, HANDLING, AND DISPOSAL OF HAZARDOUS GENERAL USE CONSUMABLES**

THIS CHAPTER SUPERSEDES CHAPTER 670 DATED 3 DECEMBER 1996

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## CHAPTER 670

### STOWAGE, HANDLING, AND DISPOSAL OF HAZARDOUS GENERAL USE CONSUMABLES

#### SECTION 1.

#### INTRODUCTION

##### 670-1.1 INTRODUCTION

670-1.1.1 This chapter addresses the basic requirements and safety precautions applicable to stowage, handling, and disposal of shipboard hazardous general use consumables. These items include many of the chemical compounds and mixtures routinely used when operating, repairing, or maintaining ship systems. They are classified as Hazardous Materials (HM) because exposure to these substances can result in personnel injury or environmental damage. Unique shipboard procedures associated with HM control are discussed in the following sections. Excluded from these discussions are items not considered general use consumables, such as ammunition, explosives, pyrotechnics, propellants, radioactive materials, medicines, and items that are subjects of specific instructions or technical manuals. See [Table 670-1-1](#) for references pertaining to management of these items.

670-1.1.2 Materials ordinarily thought to be safe may be rendered hazardous under certain conditions by an uninformed user. Materials whose hazards have not been determined shall be considered potentially hazardous and any new process involving their use shall incorporate health protection and hazard control measures.

670-1.1.3 HM are found aboard ship in a wide variety of container types and sizes. Labeling is required but this is sometimes overlooked when HM is used or stored. HM may be toxic, flammable, corrosive, or a combination of these. The materials are consumable, and often have a specified useful shelf-life based on storage in a suitable environment. Shelf-life varies with environmental conditions.

##### 670-1.2 DEFINITIONS

670-1.2.1 Personnel should become familiar with definitions relevant to shipboard HM. Specialized terms are defined in appropriate places within the text. The following terms are used throughout this chapter when discussing the management of hazardous general use consumables.

- a. Hazardous Material (HM) . Any material that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may pose a substantial hazard to human health or the environment when released or spilled into the environment.
- b. Hazardous Waste (HW) . Any discarded material (liquid, solid, or gas) that meets the definition of an HM or is designated as HW by the Environmental Protection Agency or state or local authority.
- c. Cargo . Material carried for distribution to other ships or activities and not for use by ship's force.
- d. Caustic . Alkaline material with corrosive properties.
- e. Combustible Material . See Flammable and Combustible Materials.
- f. Corrosive Material . A solid, liquid, or gas that degrades other substances (especially metals) through chemical action, or burns, irritates, or destructively attacks organic tissue. This includes strong acids and bases (alkalies or caustics).

- g. Disposal . The final disposition of HW (including overaged and redesignated HM) through overboard discharge or shore disposal.
- h. Flammable and Combustible Materials . All liquids, solids, and gases having a flashpoint below 200° F, and selected materials such as coolants, hydraulic fluids, lubricants, and aerosols, which require protection from ignition sources regardless of flashpoint.
  - 1 Category I Flammables and Combustibles: Materials having a flashpoint below 200° F and all aerosols. These materials are assigned storage codes F1 through F5 in the Hazardous Materials Information System (HMIS). They have fire hazard codes of 2, 3, or 4 and storage code G in the Consolidated Hazardous Items List (CHIL). Category I flammables and combustibles are referred to as flammables .
  - 2 Category II Combustibles: Materials with flashpoints at or above 200° F that require protected storage because they represent major fire hazards. These materials are assigned HMIS storage code F6, and CHIL storage code G and fire hazard code 1. This category does not include paper, cardboard, clothing, and similar materials considered combustible by National Fire Protection Association (NFPA).
- i. Flashpoint . The minimum temperature of a flammable liquid at which it gives off sufficient vapor to form an ignitable mixture with air near the surface of the liquid.
- j. Handling . The transporting, transferring, loading, pumping, or packaging of HM or HW, and the actual use of HM.
- k. Hazardous Material Turned In to Store (HMTIS) . HM that is no longer needed by a ship and is awaiting transfer to a shore activity. Remaining shelf life shall be greater than 6 months from the date it is turned in.
- l. HM/HW Coordinator . Person designated by the Commanding Officer to be responsible for proper shipboard management of HM, HW, and HMTIS according to NAVSEA S9593-A7-PLN-010, Shipboard HM/HW Management Plan and OPNAVINST 5090.1, Environmental and Natural Resources Protection Manual .
- m. Incompatible HM/HW . Any materials that react with each other to produce undesirable products.
- n. Irritant . Any substance which, in contact with living tissue, will cause burning or itching.
- o. Oxidizing Material . A chemical compound that spontaneously releases oxygen at normal temperature and air pressure or under slight heating. Oxidizers can react vigorously with many types of materials, especially organic substances such as petroleum products.
- p. Reactive Material . A solid, liquid, or gas that is chemically unstable at normal temperature and air pressure, and is capable of undergoing violent change when subjected to heat, shock, mixture with water, or mixture with other chemicals.
- q. Storage . The holding of HM or HW for a temporary period, after which time the HM is used or stored elsewhere, or the HW is treated, disposed of, or stored elsewhere.
- r. Toxic Material . A solid, liquid, or gas that can damage living material, impair the central nervous system, or cause illness or death through inhalation, ingestion, or skin absorption.
- s. Vital Spaces . Those spaces in which continued operation is essential for maintaining ship control, propulsion, communications, seaworthiness, and fighting capability. The following acronyms, relevant to HM control, are used throughout this chapter.
- t. Consolidated Hazardous Items List (CHIL ), NAVSUP Pub 4500.
- u. Department of Transportation (DOT ).
- v. Hazardous Materials Information System (HMIS ).

- w. Emergency Escape Breathing Device (EEBD ). An EEBD is to be used for escape only. It is not considered a self-contained Breathing Apparatus. See NSTM Chapter 079, Volume 3, Damage Control - Engineering Casualty Control , for further information.
- x. Material Safety Data Sheet (MSDS).
- y. National Fire Protection Association (NFPA ).
- z. National Item Identification Number (NIIN ).
- aa. Oxygen Breathing Apparatus (OBA ).
- ab. Personnel Protective Equipment (PPE ).
- ac. Self-Contained Breathing Apparatus (SCBA ). Supplies air for not less than 30 minutes.
- ad. Spill Contingency Plan (SCP ).
- ae. Spill Prevention, Control, and Countermeasures (SPCC ).

**Table 670-1-1** INFORMATION SOURCES FOR HM MANAGEMENT

Publication Number	Publication Title
DOD Instruction 6050.5	The DOD Hazardous Material Information System (HMIS)
<p>Note</p> <p>This microfiche system provides information on approximately 16,000 HM's used by DOD agencies. The HMIS is distributed to all ships and is maintained by the Safety Officer. Hazardous components, physical properties, recommended safety, handling, and storage procedures, and proper spill response procedures are presented for each material.</p>	
NAVMED Pub P-5112	Navy Environmental Health Bulletins
<p>Note</p> <p>These are data sheets describing hazardous chemicals typically used by Navy personnel and describing their hazards. Physiological hazards and emergency first aid procedures are included.</p>	
OPNAV Instruction 5090.1	Environmental and Natural Resources Protection Manual
OPNAV Instruction 5100.19	Navy Safety Precautions for Forces Afloat
OPNAV Instruction 5100.23	Navy Occupational Safety and Health Program Manual
NAVSEA Instruction 5100.3	Mercury, Mercury Compounds, and Components Containing Mercury or Mercury Compounds; control of
NAVSEA S9593-A7-PLN-010	Shipboard Hazardous Material/Hazardous Waste Management Plan
NAVSEA S9593-A8-PLN-010	Hazardous Materials/Hazardous Waste Spill Prevention, Control, and Countermeasures (SPCC) Plan
NAVSEA S9593-A1-MAN-010	Shipboard Management Guide for Polychlorinated Biphenyls (PCB's)
NAVSEA S9593-A9-PLN-010	Hazardous Material/Hazardous Waste Spill Contingency Plan
NAVSUP Instruction 5100.27	Navy Hazardous Material Control Program
NAVSUP Pub 4500	Consolidated Hazardous Items List
<p>Note</p> <p>This publication is being phased out and replaced with HMIS</p>	
National Fire Protection Association (NFPA) Pub 325M	Fire Hazard Properties of Flammable Liquids, Gasses, and Volatile Solids

**Table 670-1-1** INFORMATION SOURCES FOR HM MANAGEMENT -

Continued

Publication Number	Publication Title
<p style="text-align: center;">Note</p> <p>This publication may be obtained from the Navy Publications and Forms Center, Philadelphia, PA 19120, at no charge.</p>	
S9086-CH-STM-030	NSTM Chapter 074, Volume 3, Gas Free Engineering
S9086-CN-STM-020	NSTM Chapter 079, Volume 2, Damage Control - Practical Damage Control
S9086-G1-STM-020	NSTM Chapter 223, Volume 2, Submarine Storage Batteries - Silver-Zinc Batteries
S9086-H7-STM-010	NSTM Chapter 262, Lubricating Oils, Greases, Specialty Lubricants and Lubrication
S9086-KR-STM-010	NSTM Chapter 313, Portable Storage and Dry Batteries
S9086-RW-STM-010	NSTM Chapter 516, Refrigeration Systems
S9086-SN-STM-010	NSTM Chapter 541, Ship Fuel and Fuel Systems
S9086-SP-STM-010	NSTM Chapter 542, Gasoline and JP-5 Fuel Systems
S9086-SX-STM-010	NSTM Chapter 550, Industrial Gases; Generating, Handling and Storage
S9086-S4-STM-010	NSTM Chapter 556, Hydraulic Equipment (Power Transmission and Control)
S9086-T8-STM-010	NSTM Chapter 593, Pollution Control
S9086-VD-STM-000	NSTM Chapter 631, Preservation of Ships in Service (Surface Preparation and Painting)
S9086-VH-STM-010	NSTM Chapter 635, Thermal, Fire, and Acoustic Insulation

**670-1.3 RESPONSIBILITIES**

670-1.3.1 GENERAL. Responsibilities for the management of HM and HW are outlined in OPNAVINST 5100.23 Navy Occupational Safety and Health Program Manual ; OPNAVINST 5090.1, Environmental and Natural Resources Protection Manual ; NAVSEA S9593-A7-PLN-010, Shipboard HM/HW Management Plan . To identify potential problems with HM and for specific instructions, use the references listed in [Table 670-1-1](#).

670-1.3.2 COMMANDING OFFICERS. Commanding Officers of Navy ships are responsible for:

- a. Ensuring that shipboard personnel comply with specifications of this chapter for the stowage, handling, and disposal of HM, HW, and HMTIS.
- b. Ensuring that shipboard personnel who handle HM are properly trained and familiar with applicable Navy HM/HW regulations and safety precautions.
- c. Reporting to the Fleet Commander conditions or system malfunctions that result in an HM/HW discharge in restricted waters.

670-1.3.3 HM/HW COORDINATOR. HM/HW Coordinator's responsibilities:

- a. Ensure that management of HM/HW is according to established procedures.

- b. Attend appropriate HM/HW training courses.
- c. Train supervisors in proper handling, stowage, usage, disposal and labeling procedures of HM/HW. Also train supervisors in the use of MSDS and HM/HW regulations regarding spills and spill prevention planning.
- d. Ensure that the locations and quantities of hazardous materials kept onboard ship are identified and note places where spills are most likely to occur (for example, storage, work, and transfer areas).
- e. Ensure that locations where HM/HW are stored or used are regularly inspected and that improperly labeled, segregated, or stowed HM/HW is reported to the HM/HW Coordinator.
- f. Ensure that an inventory of HM onboard ship is developed and updated on an annual basis. The inventory shall include the following:
  - 1 Trade or generic name of the material.
  - 2 Federal stock number of the material or manufacturer's stock number
  - 3 Hazard category of the material (flammable, toxic, and so forth)
  - 4 Location of the material
  - 5 Quantity of the material
  - 6 Shelf life expiration or retest date of the material
  - 7 Size of the container
  - 8 Manufacturer name
  - 9 Authorized location.
- g. Ensure that there is a valid requirement for HM onboard ship and that the quantity of HM does not exceed the minimum operational requirement.
- h. Ensure that every item of HM onboard has a MSDS and that it is readily available to all personnel.

670-1.3.4 SAFETY OFFICER. The Safety Officer is responsible for:

- a. Providing shipboard personnel with safety information concerning HM/HW operations.
- b. Ensuring that approved PPE are available for HM/HW operations and that clothing and equipment are properly used and maintained.
- c. Acquiring and maintaining a central file of MSDS and distributing copies to work centers that handle particular HM/HW.
- d. Acquiring and maintaining a central file of the Navy Environmental Health Bulletins and distributing to supervisory personnel.
- e. Acquiring and maintaining the microfiche output of the DOD HMIS and distributing to supervisory personnel.
- f. Ensuring that personnel routinely engaged in HM/HW operations are included in the ship's established Medical Surveillance Program, according to Navy instructions (OPNAVINST 5100.19 and 5100.23).
- g. Maintaining reports of unsafe shipboard conditions involving HM/HW in a hazard reporting file for use in analysis and corrective action.

670-1.3.5 SUPPLY OFFICER. The Supply Officer is responsible for:

- a. Properly labeling and storing HM taken aboard according to established standards and precautions.

- b. Determining stock levels for HM and minimizing the amount taken onboard ship.
- c. Minimizing open procurement of HM. When open purchase items are required, an MSDS shall be obtained.
- d. Maintaining records of stock levels, locations, and usage of HM.

**NOTE**

The responsibilities for gasoline, as listed above, pertain to the Fuels Division aboard ships.

670-1.3.6 SUPERVISORS. Supervisory personnel are responsible for:

- a. Ensuring that subordinate personnel are trained in procedures for handling HM/HW and are familiar with regulations and spill planning.
- b. Ensuring that safety practices are followed when HM is being handled.
- c. Properly labeling containers to which HM or HW is transferred, and ensuring the integrity of those containers.
- d. Maintaining inventories for HM used and HW generated in the course of ship operations.
- e. Limiting quantities of HM stored in work areas to in-use quantities as outlined in [Section 2](#) and [Section 4](#).
- f. Reporting unsafe shipboard conditions involving HM/HW to the Safety Officer, and taking action to correct these conditions.
- g. Immediately reporting to the On-Scene Commander, spills or accidents involving HM/HW.
- h. Ensuring that copies of applicable MSDS and Navy Environmental Health Bulletins are available in areas under their cognizance.

670-1.3.7 SUBMARINE TYPE COMMANDERS. Submarine Type Commanders shall promulgate additional restrictions relative to atmosphere contaminants in submarines. Where conflict exists, such restrictions take precedence over those listed in this chapter.

## **670-1.4 PROHIBITED OR RESTRICTED HM**

670-1.4.1 Because of their high degree of hazard, certain materials are prohibited from shipboard use while other materials are authorized with specific restrictions. Because controls over materials are part of the Navy stock system, open purchase of materials may bring prohibited HM aboard ship. Unauthorized materials that have not been reviewed by the Navy may be equally hazardous. A material that is safe for one application might be hazardous if used for another purpose. To minimize material hazards, use the following procedure:

1. Check requisitions and purchase requests to ensure no prohibited items are ordered.
2. Use only materials specified in maintenance requirement cards or in operating guidance.
3. Avoid open purchase of HM unless procured to military specifications or equipment technical manual requirements. Chemical composition of open purchase materials may not be the same as those meeting stock system specifications, and may be more hazardous.
4. Check current stock levels to prevent purchase of excess quantities of HM.

5. Obtain MSDS's from the supplier for HM open purchased. Send one copy of each MSDS to: Commanding Officer, Navy Environmental Health Center, Naval Station, Norfolk, VA, 23511-6695.

670-1.4.2 The following material is prohibited aboard surface ships and submarines, regardless of the stock number used in procurement.

- a. Benzene (benzol)
- b. Carbon tetrachloride
- c. Chloroform
- d. Chlorinated lime
- e. DDT insecticide
- f. Dry cleaning solvent (FED Spec P-D-680, Type I)
- g. Methyl bromide insecticide
- h. Plastic trash cans.

670-1.4.3 The following stock numbered items are also prohibited.

- a. Calcium Hypochlorite, 100-pound drum, NSN 6810-00-255-0472
- b. Extension light: NSN
  - 6230-00-140-1165
  - 6230-00-239-3518
  - 6230-00-239-3523
  - 6230-00-240-3759
  - 6230-00-729-9259
  - 6230-00-901-9755

670-1.4.4 The following materials are not to be stored or used aboard surface ships or submarines (except where authorized in Medical Department pharmacies, clinical and chemical laboratories, as cargo on surface ships, or as indicated below).

- a. (beta) Naphthylamine
- b. DDT xylene emulsion
- c. Hydrocyanic acid gas
- d. Tetrachloroethane (acetylene tetrachloride).
- e. Trichlorethylene (to be used only on tenders and repair ships equipped with mechanical hot degreasers with attached exhausts, designed for use with trichlorethylene).
- f. Gasoline (except when stowed according to the requirements of paragraphs [670-4.7.2](#) through [670-4.7.2.3.1](#)).
- g. Sulfuric acid storage battery electrolyte, Class 1, specific gravity 1.835 [to be used only on ships with a requirement to activate dry batteries and equipped with freshwater deluge showers (see NSTM Chapter 313)].

670-1.4.5 The following materials are not to be used or stored aboard submarines (except where authorized in Medical Department pharmacies or clinical and chemical laboratories).

- a. Mercury
- b. Dry mercury batteries (except those contained in cameras and wristwatches)
- c. Perchloroethylene (tetrachloroethylene)
- d. Trichloroethane (inhibited methyl chloroform)
- e. Steel wool
- f. Ethyl alcohol
- g. Dry cleaning solvent (FED Spec P-D-680, Type II)
- h. Pressurized dispensers (aerosol cans).

670-1.4.6 The following material is authorized for limited use aboard surface ships for equipment degreasing and cleaning. This material may not be used in or carried for shipboard dry cleaning equipment: Solvent (FED Spec P-D-680, Type II). NSN

6850-00-110-4498

6850-00-274-5421

6850-00-285-8011

6850-00-281-1986

670-1.4.7 Perchloroethylene (tetrachloroethylene) is authorized for use in dry cleaning equipment aboard surface ships. NSN

6850-00-819-1128

6850-00-270-9982

670-1.4.8 The following items are specifically approved for issue to ships and submarines.

- a. Calcium hypochlorite:

NSN

6810-00-242-4770

(unit of issue is six 3.75-pound bottles/box)

6810-00-255-0471

(unit of issue is one 6-ounce bottle)

- b. Electrical extension light:

NSN

6230-00-244-3996

6230-00-283-9671

6230-00-548-0199

6230-00-701-2947

670-1.4.9 For additional information regarding material approved for submarine use, consult S9510-AB-ATM-010/(C) (NOTAL) SUB ATM CONT, Nuclear Powered Submarine Atmosphere Control (U) . Where conflict exists, restrictions promulgated by Submarine Type Commanders take precedence over those listed in this chapter.

## 670-1.5 HAZARD IDENTIFICATION

670-1.5.1 Evaluating HM hazards so that safety precautions are followed requires consideration of:

- a. Types and amounts of HM present. The hazards of a material will be described on the container label, in MSDS, in the HMIS, or in available references ([Table 670-1-1](#)). To determine concentrations of hazardous gases consult the Gas Free Engineer.
- b. Ways in which personnel may be exposed, such as inhalation, absorption through the skin, or ingestion.
  - 1 Inhaled toxic substances can quickly enter the bloodstream to attack vital organs. Personnel may not be aware that they are breathing toxic levels of a gas if it is odorless or at low concentrations. Gases may concentrate at the lowest point of a compartment. Volatile liquids will vaporize easily, causing vapors to build up in confined spaces.
  - 2 Absorption through the skin is the most probable form of exposure when handling HM. Many HM cause skin irritation or damage to internal systems if absorbed through the skin.
  - 3 Ingestion may occur if personnel smoke, eat, or drink during operations involving HM, or do not thoroughly wash after handling HM.
- c. Adequate ventilation to the area in which HM is used.
- d. The number of personnel (including standby personnel) who shall use protective clothing or equipment while handling HM; and estimating the length of time personnel may be exposed.
- e. The presence of hazardous conditions, such as elevated temperatures, restricted entry or exit, slippery decks, and rough seas.

670-1.5.2 Specific hazards for handling selected HM are given in later sections. Hazards to personnel include:

- a. Direct exposure to a hazardous substance.
- b. Fires resulting from ignition or explosion of flammable, combustible, or reactive materials. This includes the risk of smoke inhalation and exposure to toxic fumes from burning materials, such as plastics.
- c. Oxygen-deficient atmospheres, through depletion of oxygen during a chemical fire or reactions of spilled materials. Oxygen deficiency can also result when dense chemical vapors within an enclosed space, such as a storage area, displace normal breathing air.
- d. Improper use of PPE or exceeding design limits of PPE can be extremely dangerous. Extended use of confining or heavy equipment may also cause stress, overheating, fatigue, and temporary disorientation. This impairs judgement or causes physical weakness, which may lead to injury or illness.

## **670-1.6 SAFETY PRECAUTIONS**

670-1.6.1 Personnel handling HM shall use PPE and be trained in the equipment's proper use and maintenance. If HM contacts skin or eyes, flush immediately with water and obtain medical attention. See the section for the type of HM involved to obtain specific first aid instructions.

670-1.6.2 When handling or storing HM, personnel shall be familiar with the locations and operations of emergency response and first aid equipment as well as the location and operation of remote jettison capability. Personnel shall not smoke, eat, or drink in areas where HM is present. Open flames and sparking materials are prohibited in HM stowage and transfer areas.

670-1.6.3 Observe good housekeeping at all times in areas of HM use and stowage. Aisles and passageways shall permit free movement of personnel, equipment, and materials (minimum of 24 inches in HM stowage areas). Access to all exits, safety equipment, alarms, and fire extinguishing equipment shall be unobstructed at all times. Areas shall be clean, dry, uncluttered, and adequately ventilated.

670-1.6.4 Keep HM present in work spaces to a minimum. Confine stowage of all materials, including HM, to designated stowage facilities. Under no circumstances shall spaces not designated for stowage be used for stowage.

670-1.6.5 Segregate incompatible hazardous materials at all times (see [670-1.11](#)). Do not mix any HM with any other material unless specifically required for operating procedures.

670-1.6.6 Maintain ventilation and fire suppression systems, emergency equipment such as deluge showers and spill clean-up kits, and PPE in good working condition. Inspect equipment according to Planned Maintenance System (PMS) requirements or at least monthly. Ventilation exhaust ports and access to firefighting equipment shall not be blocked by equipment or materials.

670-1.6.7 During extensive operations involving HM, at least two crewmen shall be present in case emergency assistance is required. Unauthorized or inadequately protected personnel shall not enter HM stowage and handling areas. MSDS for HM onboard ship shall be available to all personnel.

670-1.6.8 Electrical switches and devices not certified as explosion-proof shall not be turned on or off where explosive or flammable gases are known or suspected to be present.

670-1.6.9 Spill prevention and control measures shall be strictly applied and enforced. Features designed to prevent spills or minimize spread of spilled material, such as coamings, barriers, and seals around drains and doors, shall be maintained in good condition.

670-1.6.10 Keep ventilation intakes clear of HM at all times.

## 670-1.7 SPILL EMERGENCIES

670-1.7.1 SPILL MANAGEMENT. Ship's force shall prepare for HM spills by developing, implementing, and posting an SPCC plan and an SCP, as required by OPNAVINST 5090.1. Guidelines can be found in NAVSEA S9593-A7-PLN-010, NAVSEA S9593-A8-PLN-010, and NAVSEA S9593-A9-PLN-010.

670-1.7.2 REPORTING SPILLS. Personnel shall immediately report any HM/HW spill, either overboard or onboard, to the HM/HW Coordinator. For overboard spills, OPNAVINST 5090.1; NSTM Chapter 593; and NAVSEA S9593-A9-PLN-010 the HM/HW Spill Control and Prevention Manual , provide detailed guidance.

670-1.7.3 SPILL RESPONSE. Personnel shall carry out the following spill response measures appropriate for the material hazards and the extent of the spill:

### **WARNING**

**Unprotected personnel shall not attempt to clean a spill unless the spilled materials are known to be nonhazardous and no dangerous conditions, such as oxygen-deficient atmospheres, exist. If a known HM or an unknown substance is spilled, notify the HM/HW Coordinator at once.**

1. Evacuate personnel from the spill area and cordon off the area. Wear PPE when rescuing personnel in the spill area.
2. Provide first aid to injured personnel.
3. Use protective clothing and equipment appropriate for the hazards of the spilled material and the scope of the clean-up operation.
4. Stop the spill source.
5. Eliminate ignition sources.
6. Contain the spill using coamings or absorbent material.
7. Follow clean-up procedures established in the ship's HM/HW SCP.

## 670-1.8 PERSONNEL PROTECTIVE EQUIPMENT (PPE)

670-1.8.1 GENERAL. PPE is required to minimize the hazards of handling HM or when dangerous shipboard conditions involving HM (such as a spill) exist. Appropriate PPE shall be readily available near HM stowage areas or where HM is used extensively. Stowage of PPE shall be in clearly labeled cabinets or lockers. Safe use of PPE requires identification of the hazards of the HM being handled, selection of gear that effectively protects against these hazards, careful use of approved gear, and proper decontamination and maintenance of equipment. To select appropriate PPE, consult PMS or operating guidance, the HMIS, or MSDS maintained by the Safety Officer or Supply Officer.

Additional information about protective equipment used by Navy forces is available in OPNAVINST 5100.19; NSTM Chapters 074, Volume 3; 079, Volume 2; 631; and 635. [Table 670-1-2](#) provides a list of PPE available through the Navy stock system.

**670-1.8.2 PPE TYPES.** The kinds of protective devices suitable for use during HM operations can be classified according to the areas of the body protected.

**Table 670-1-2** AVAILABLE PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Item	Description	Manufacturer	Part No.	CG NSN
Apron, butyl	Small Medium Large			9D 8415-00-281-7813 9D 8415-00-281-7814 9D 8415-00-281-7815
Apron, plastic	Clear, flexible vinyl chloride plastic film, designed for use in laboratories			9D 8415-00-715-0450
Apron, rubber				9D-8415-00-082-6108
Boot covers, butyl	Small Medium Large			9D 8430-00-262-5295 9D 8430-00-262-5296 9D 8430-00-262-5297
Boot covers, disposable	Plastic vinyl, one size only			9D 8430-00-591-1359
Boots, rubber	Size 7, 15-inch Size 8, 15-inch Size 9, 15-inch Size 10, 15-inch Size 11, 15-inch			9D 8430-00-262-8254 9D 8430-00-262-8255 9D 8430-00-262-8256 9D 8430-00-262-8257 9D 8430-00-262-8258
Coveralls, Disposable	Tyvek, Saranex laminated - hooded, booted	Dupont		
Coveralls, toxicological	Small Medium Large			9D 8415-00-099-6962 9D 8415-00-099-6968 9D 8415-00-099-6970

**Table 670-1-2 AVAILABLE PERSONAL PROTECTIVE CLOTHING AND  
EQUIPMENT - Continued**

Item	Description	Manufacturer	Part No.	CG NSN
Coverall, work, white cloth	Small Medium Large Xtra large			9D 8405-00-082-5536 9D 8405-00-082-5537 9D 8405-00-082-5538 9D 8405-00-082-5539
Cream, skin protective	Water dispersible Water miscible Water insoluble			9G 6850-00-244-4893 9G 6850-00-244-4894 9G 6850-00-244-4892
Ear protectors	Plug type, box of 200			9L 6515-00-137-6345
Emergency oxygen unit	Includes refillable tank, regulator, and mask	Lab Safety	H4155	
Faceshield, amber	Nontilting			9G 4240-00-240-5140
Faceshield, Industrial	Tilting Nontilting			9Q 4240-00-542-2048 9Q 4240-00-240-5141
First aid kit	General			9L 6545-00-919-6650
Fully encapsulating suit	Chempruf II Vautex Chempruf II Betex	MSA MSA	665514 695515	
Gloves, butyl	Small Medium Large Xtra large			9D 8415-00-753-6551 9D 8415-00-753-6552 9D 8415-00-753-6553 9D 8415-00-753-6554
Gloves, industrial, designed for handling corrosives	Small Medium Large Xtra large			9D 8415-00-266-8673 9D 8415-00-266-8675 9D 8415-00-266-8677 9D 8415-00-266-8679

**Table 670-1-2** AVAILABLE PERSONAL PROTECTIVE CLOTHING AND  
EQUIPMENT - Continued

Item	Description	Manufacturer	Part No.	CG NSN
Gloves, industrial, designed for handling organic solvents	Small Large			9D 8415-00-823-7456 9D 8415-00-823-7457
Gloves, industrial, designed for handling organic solvents	Small Large			9D 8415-00-753-6551 9D 8415-00-823-7457
Gloves, neoprene	Small Medium Large Xtra large			9D 8415-00-753-6551 9D 8415-00-753-6552 9D 8415-00-753-6553 9D 8415-00-753-6554
Gloves, PVC	Small Large			9D 8415-00-916-2817 9D 8415-00-916-2818
Gloves, rubber	Xtra large Small Medium Large			9D 8415-00-753-6554 9D 8415-00-753-6651 9D 8415-00-753-6552 9D 8415-00-753-6653
Gloves, rubber latex	One size only			9D 8415-01-012-9294
Goggles	Chemical splash type, ventilated			9Q 4240-00-052-3776
Hardhat	White			9Q 8415-01-025-9958
Jacket, chloroprene	Small, hooded Medium, hooded Large, hooded			9D 8405-01-051-8390 9D 8405-01-051-8391 9D 8405-01-051-8392

**Table 670-1-2 AVAILABLE PERSONAL PROTECTIVE CLOTHING AND  
EQUIPMENT - Continued**

Item	Description	Manufacturer	Part No.	CG NSN
Overalls, chlorprene, bib front, high back	Small Medium Large			9D 8405-01-051-2914 9D 8405-01-051-2915 9D 8405-01-051-2916
Pants, disposable	Polyethylene coated olefin fabric			9D 8415-01-0134839
Portable eyewash	15-minute spray duration - consists of water tank and eyewash apparatus			9G 4230-01-041-3473
Respirator, cartridge	Acid-gas Ammonia Dust, mist, fumes Organic vapor Pesticide	3M 3M	8417 8427	9G 4240-00-084-9394 9G 4240-00-022-2524 9G 4240-01-035-9250
Respirator, supplied air	Full facepiece, pressure-demand type Full facepiece with auxiliary SCBA, pressure-demand type	Scott	P/N900055-52	9G 4240-00-275-3178
SCBA	Full facepiece, pressure-demand type Model 401 Air Mask pressure-demand type, 30-minute duration	Scott MSA	Air Pac (TM)	1H 4240-00-919-2864
SCBA replacement part	Spare air cylinder for MSA, SCBA, steel, 30-minute duration	MSA	94007	1H 1045-01-111-8264
Shirt, disposable	Polyethylene-coated olefin fabric			9D 8415-01-014-5359

670-1.8.2.1 Respiratory Protective Equipment. Respiratory protective equipment is used to counter hazardous air contaminants or oxygen-deficient atmospheres. The two types are air-purifying respirators and supplied-air respirators.

- a. Filter masks and chemical-cartridge respirators are air-purifying respirators. They cleanse breathing air through use of mechanical filters, chemical absorbents, or both. They are useful when atmospheres contain only particulate contaminants, but they cannot be used in highly toxic or oxygen-deficient atmospheres.
- b. Supplied-air respirators feed air or oxygen from supplies isolated from the work-place atmosphere, into an enclosed face mask or helmet. Examples are hose masks and airline systems, and OBA. They are necessary when the atmosphere is highly contaminated or is oxygen-deficient.

670-1.8.2.2 Head and Face Protective Devices. Head and face protective devices to prevent injury from flying objects or chemical splashes include:

- a. Helmets or hardhats, to protect against blows to the head
- b. Face shields, to be attached to a helmet, to provide full-face splash and splatter protection
- c. Hoods, to protect the head, face, and neck from hazardous chemicals
- d. Face masks, such as respirator components, to provide face protection against chemical splashes and mists. The degree of protection varies with the type of mask.

670-1.8.2.3 Eye Protection. Eye protective equipment protects against chemical vapors, mists, gases, dusts, and splinters. Eye protection may be required even when general face protection is considered unnecessary. The following provide eye protection:

- a. Safety glasses with sideshields, to protect against direct splashes and flying objects, but which are not gastight
- b. Splash goggles, which protect against liquid HM and are resistant to gases
- c. Gas goggles, which are gastight
- d. Face shields, which when used with safety glasses, protect the eyes from HM splashes and mists.

670-1.8.2.4 Foot Protection. The following items provide foot protection against falling objects and spills.

- a. Safety shoes or boots, made from leather or rubber and reinforced with steel toe, instep, or sole inserts. Non-skid soles might be necessary to prevent sparks when handling volatile chemicals.
- b. Splash boots, to protect shoes and feet from HM spills. These are frequently worn over safety shoes.

670-1.8.2.5 Hand Protection. Hand protection prevents injury from HM or falling objects. This equipment includes:

- a. Work gloves of leather or heavy cloth, to provide impact protection and insulation. These offer little or no protection from HM, but can be worn over chemical-resistant gloves.
- b. Impervious and chemical-resistant gloves, made of rubber or synthetic materials. Different glove materials provide varying protection against different chemicals. For example, vinyl gloves are more resistant to sulfuric acid than rubber gloves, but rubber gloves provide better protection than vinyl gloves against cyclohexanone.
- c. Barrier creams, used alone or under gloves, to protect against skin sensitizers or irritants such as epoxy resins.

670-1.8.2.6 Full Body Protection. Full body protective clothing provides protection against HM spills, splashes, and mists. This clothing includes:

- a. Aprons, covering the front of the body from ankles or knees to the chest
- b. Chemical-resistant coveralls, which may be disposable

- c. Chemical-resistant splash suits, which are typically reusable
- d. Fully-encapsulating suits that completely isolate the wearer from atmospheres and contact with HM.

670-1.8.3 PPE USES. The following guidelines apply to fundamental aspects of PPE use:

- a. Personnel expected to use PPE, especially respiratory equipment, shall be trained in the operation and limitations of that equipment. Limitations include:
  - 1 Oxygen supply of OBA canisters
  - 2 Limitations to type of HM and concentrations for absorbent cartridges and canisters
  - 3 Mist and vapor tightness of goggles or splash suits
  - 4 Material impermeability limitations for gloves and clothing
  - 5 Limitations in effective work radius when using airline respirators
  - 6 Reduced dexterity when using protective gloves, especially when two pairs are worn
  - 7 Reduced ability to communicate when using full face mask respirators.
- b. Users of HM shall be familiar with locations and availabilities of PPE, particularly for responding to spill emergencies.
- c. PPE shall be fit-tested to ensure proper sealing and usability before use (or anticipated use in the case of designated spill response personnel). Fit-testing is mandatory for respiratory protective devices.

670-1.8.4 PPE MAINTENANCE. Maintenance requirements for respiratory protective equipment are presented in OPNAVINST 5100.19. The guidelines in the following paragraphs apply to basic PPE maintenance.

Decontaminate reusable equipment before storage or reissue and reuse, using the following procedure:

- 1. Disassemble the equipment, if appropriate.
- 2. Gently scrub parts until free of dirt and contaminating substances. Use 1-percent solution (approximately 2 oz/gal) of detergent such as NSN 6480-00-985-6896 in cold or warm water.

#### NOTE

Avoid strong cleaning agents, hot water, and abrasive scrubbing. Solvents can degrade rubber, neoprene, and other components of protective gear, and should only be used according to maintenance guidelines.

- 3. Disinfect equipment, especially respirators, glasses, goggles, and gloves. Use an approved disinfectant such as NSN 6840-00-584-3129.
- 4. Completely rinse and thoroughly dry equipment. Respirators should be allowed to dry in an uncontaminated atmosphere.
- 5. If appropriate, reassemble decontaminated equipment.
- 6. Handle items that cannot successfully be decontaminated as HW (see NSTM Chapter 593).

PPE shall be inspected by trained personnel for signs of wear, deterioration, or damage. Inspections shall be performed on a monthly basis, and before and after each use. Defective equipment shall not be used. If defective components cannot be replaced, the entire item shall be removed from service until replacement parts are available.

Parts replacement on assembled protective devices, especially respirators, can only be performed by qualified personnel, such as the Safety Officer or Damage Control Assistant (DCA). Untrained personnel shall not attempt repairs. Parts made by different manufacturers cannot be interchanged between protective devices.

Decontaminated and inspected protective equipment shall be stowed in a cool, clean, and dry location, free from moisture accumulation and the risks of HM attack or mechanical damage.

## **670-1.9 LABELING**

670-1.9.1 DOT and NFPA labels are extensively used to identify hazardous items. The DOT label is used to warn personnel of a material's primary hazard (such as flammability or toxicity) rather than its specific effects. The NFPA label provides more detailed information about health, fire, reactivity, and unique hazards of HM, using a numeric code. The NFPA label is described in the CHIL. Refer to NSTM Chapter 593 and NAVSUPINST 5100.27 for guidance on labeling.

670-1.9.2 The Supply Department is responsible for ensuring the HM brought aboard ship is properly labeled before stowage and issue. Supervisory personnel shall ensure that HM stowed or used in areas under their cognizance is properly labeled. Questions regarding HM labeling shall be directed to the Supply Officer, the Safety Officer, or the HM/HW Coordinator.

670-1.9.3 Precautionary labels shall be affixed to each individual container of HM. Labels shall firmly adhere to the container's surface. Any grease, oil, or moisture shall be removed before label is applied. HM labels shall be prominently displayed. Labels shall not obscure any other identifying markings on HM containers.

670-1.9.4 If HM is transferred from one container to another, the new container shall be labeled in the same manner as the original container.

670-1.9.5 Warning labels on containers shall not be removed until all HM has been removed using procedures described in NSTM Chapter 593.

## **670-1.10 HM CONTAINERS**

670-1.10.1 INSPECTIONS. Damage to containers, including dents, pitting, rust, creases, cracks, and damage to closures and gaskets, may lead to leakage and dangerous HM spills. Containers in flammable liquid stowage facilities shall be inspected weekly. Containers of other HM shall be inspected monthly and inventoried quarterly. Inspect for the following conditions:

- a. Tightness of closure for caps, bungs, vent plugs, and drum ring/locks
- b. Corrosion of containers
- c. Leakage, especially at bungs, vent plugs, chimes, seams, and caps
- d. Improper or inadequate labeling
- e. Elapsed shelf life
- f. Bulging of cans or drums.

670-1.10.2 **DEFECT CORRECTION.** If a potentially hazardous condition cannot be easily corrected, report the situation to the HM/HW Coordinator or DCA immediately. Defects discovered during HM container inspections shall be corrected as follows:

1. Tighten closures if they are undamaged.
2. Replace damaged closures.
3. Transfer contents of a damaged container to a new properly labeled container, and handle the emptied container as HW.
4. If shelf life has elapsed, contact the HM/HW Coordinator or Supply Officer.

#### NOTE

Materials shall be issued on a first-in, first-out basis to avoid problems with shelf life lapses.

4. Obtain and apply required precautionary labels.

670-1.10.3 Bulging containers indicate a potentially dangerous reaction within the container. Notify the HM/HW Coordinator and DCA immediately. Do not handle or vent the container if assistance from a shore facility can be obtained. Contact the Navy Environmental Health Center. Use HMIS to assess the hazards of the material in the container to determine if venting to relieve internal pressure is advisable. If so, vent only in a well-ventilated and fire-protected area (preferably the weather deck), with damage control personnel standing by. The container and contents are to be considered HW, and disposed of according to existing instructions.

670-1.10.4 HM containers shall be compatible with the substances they are to contain. [Appendix A](#) provides compatibility data for common shipboard materials. **NSTM Chapter 593** discusses DOT specifications for containers. Only containers with appropriate DOT specification markings shall be used.

670-1.10.5 The original HM container shall be used for storing the corresponding HW. If the original container cannot be used, HM containers that are thoroughly cleansed of residues can be reissued to contain any HW compatible with the container type. Cleaning procedures are discussed in **NSTM Chapter 593**.

### 670-1.11 INCOMPATIBLE HAZARDOUS MATERIALS

670-1.11.1 The mixing of incompatible substances can produce heat, fire, explosion, or toxic or flammable fumes. Transferring HM to a container made of an incompatible material can corrode the container and cause it to leak or burst. [Table 670-1-3](#) provides cross-reference information for HM containers. [Table 670-1-4](#) provides supply data for shipboard HM containers.

670-1.11.2 Observe the following safety precautions for handling incompatible HM:

1. Stow and handle incompatible materials in separate compartments to prevent mixing in the event of a spill.
2. Stow HM only in compatible containers.
3. If space limitations necessitate storing incompatibles in the same compartment, a separation distance of at least

3 feet shall be maintained. This provides only limited protection, and all precautions, such as high coamings, shall be used to prevent accidental mixing. Coamings will not prevent vapors, generated from incompatible HM in confined spaces, from mixing and reacting.

4. Do not add incompatible materials to the same waste or collection container.
5. Do not add HM to a container that has previously stored an incompatible material unless it has been purged of all residue. Purging procedures are discussed in **NSTM Chapter 593** . If the material stored previously in the container has not been identified, do not reuse the container until it has been purged.
6. Purge transfer equipment, such as pumps and hoses, of all residue before reuse. Procedures are discussed in **NSTM Chapter 593** .

**Table 670-1-3 SHIPBOARD HAZARDOUS MATERIAL/CONTAINER  
CROSS REFERENCE**

<b>Hazardous Materials</b>	<b>Containers</b>
Chlorinated Cleaning Solvents:	
Perchlorethylene	Steel drum (b/v)
Trichlorethane	Tin or steel can; steel drum (b/v)
Trichloroethylene	Tin or steel can; steel drum (b/v)
Trichlorourethane	Tin or steel can; steel drum (b/v)
Mercury and Mercury Compounds	Plastic bottle
Polychlorinated Biphenyls (PCB's)	(See note 4) Polyethylene lined steel drums, Plastic-lined steel drum, steel drum (b/v, r/c)
Fluorocarbon Compounds:	
Dichlorodifluoromethane	Original gas cylinder
Trichlorotrifluoroethane	Steel drum drum (b/v)
Organic Cleaning Solvents (Non-Chlorinated):	
Acetone	Tin can; steel drum (b/v)
Ethyl acetate	Steel drum (b/v)
Kerosene	Steel drum (b/v)
Methyl ethyl ketone	Steel drum (b/v)
Morpholine (40%)	Tin can; steel drum (b/v) (see note 2)
Naptha	Steel drum (b/v)
Stoddard solvent	Steel drum (b/v)
Toluene	Tin or steel can; steel drum (b/v)
Turpentine	Tin or steel can; steel drum (b/v)
Xylene	Tin or steel can; steel drum (b/v)
<b>Oxidizing Materials:</b>	
Ammonium dichromate	Plastic bottle; plastic-lined steel drum
Ammonium nitrate	Plastic bottle; plastic-lined steel drum
Calcium hypochlorite	Plastic bottle; plastic-lined steel drum
Chromic acid	Glass carboy
Hydrogen peroxide	Plastic bottle; plastic-lined steel drum

**Table 670-1-3 SHIPBOARD HAZARDOUS MATERIAL/CONTAINER**

## CROSS REFERENCE - Continued

Hazardous Materials	Containers
Mercurous nitrate	Plastic bottle; plastic-lined steel drum
Potassium dichromate	Plastic bottle; plastic-lined steel drum
Potassium nitrate	
Potassium permanganate	Plastic bottle; plastic-lined steel drum
Potassium superoxide (oxygen breathing apparatus canister)	Fiberboard box
Silver nitrate	Plastic bottle; plastic-lined steel drum
Sodium chromate	Plastic bottle
Sodium nitrate	Plastic bottle; plastic-lined steel drum
Sodium nitrite	Plastic bottle; plastic-lined steel drum
Acids:	
Acetic acid	Plastic bottle; plastic-lined steel drum
Acetic acid, glacial	Plastic bottle
Batteries (lead acid)	Steel drum (see note 3)
Battery acid (sulfuric)	Plastic bottle; plastic-lined steel drum (see note 2)
Citric acid	Plastic bottle (see note 2)
Compound, boiler passivator (oxalic acid)	Plastic-lined steel drum
Compound, descaler (caustic/acid)	Plastic-lined steel drum
Formic acid (nickel electroplating solution)	Plastic bottle; plastic-lined steel drum
Hydrochloric acid	Plastic bottle (see note 2)
Nitric acid	Glass carboy
Paint remover (caustic)	Plastic bottle; plastic-lined steel drum
Sulfamic acid, solid	Plastic-lined steel drum
Sulfamic acid, solution	Plastic bottle; plastic-lined steel drum
Sulfuric acid	Clear carboy; plastic bottle; plastic-lined steel drum
Alkalines:	
Ammonia solution	Plastic bottle
Sodium hydroxide, solid	Steel drum (r/c)
Sodium hydroxide, solution	Steel can; steel drum (b/v) (see note 2)
Alcohols:	
Ethylene glycol	Plastic-lined steel drum
Ethyl alcohol	Plastic bottle
Isopropyl alcohol	Plastic bottle
Methyl alcohol	Plastic bottle
Non-Fuel Oils and Lubricants:	
Grease (ball bearings, general purpose, graphite, halocarbon)	Steel drum (r/c)

**Table 670-1-3 SHIPBOARD HAZARDOUS MATERIAL/CONTAINER**

## CROSS REFERENCE - Continued

<b>Hazardous Materials</b>	<b>Containers</b>
Hydraulic fluid (petroleum)	Steel drum (r/c)
Hydraulic fluid (synthetic)	Epoxy-lined steel can; plastic-lined steel drum
Molybdenum graphite, drylube	Steel drum (r/c)
Oil, cutting (synthetic)	Epoxy-lined steel can
Oil, liquid coolant (synthetic)	Epoxy-lined steel can
Oil, NOS	Steel drum (b/v)
General Adhesives	Steel drum
Epoxy and Acrylic Resins	Steel drum
Painting Supplies:	
Lacquers	Tin can; steel drum (b/v)
Paint, enamel	Steel drum (b/v)
Thinner (organic)	Tin or steel can; steel drum
Varnish, insulating electrical	Steel drum (b/v)
Varnish, VOS	Steel drum (b/v)
Varnish, pehnolic resin	Steel drum
<b>NOTES:</b> b/v = bung and vent r/c = removable cover 1. Wherever possible, the DOT-approved container used in the original issue of the material shall be reused. 2. Bulk usage is probable in large-scale operations. 3. Typical shipboard portable wet-cell batteries vary widely in size. Accordingly, personnel shall match the size of the storage drum used to the size and number of batteries to be containerized. A standard 18-gauge, 55-gallon steel drum, for example, will accommodate, respectively, 2 BB259 batteries, 4 BB258 batteries; 6 BB257 batteries, or 40 BB255 batteries. (Weight constraints, however, may also be a factor in determining the total number of batteries per container.) Batteries shall be stored right side up. 4. For packaging and handling procedures, see <b>NSTM Chapter 593</b> .	

**Table 670-1-4 SHIPBOARD HM CONTAINERS - DESCRIPTION AND SUPPLY DATA**

<b>Type</b>	<b>National Stock Number</b>	<b>Item Description</b>	<b>Applicable Specifications (DOT, Mil, Fed)</b>
Bag	8105-00-848-9631	Polyolefin, single wall, 5 mil, 36" x 54", flat, wire tie	PPP-B-26 TY 2
Plastic bottle	8125-00-174-0852	Polyethylene, 1-gal, round, screwcap closure	MIL-B-26701
	8125-00-731-6016	Polyethylene, 13-gal, round, screwcap closure	Not available
Fiberboard box	8125-00-888-7069	Polyethylene, 5-gal, round screwcap closure	Not available
	8115-01-012-4597	Fiberboard, RSC style, 34" x 26" x 16", burst-strength 400 lb	DOT 2 C PPP-B-636 TY 5 CL4
Tin can	8110-00-879-7182	Tin, 1-gal, oblong, screwcap closure, enamel outside surface treatment	DOT 2F PPP-C-96

**Table 670-1-4 SHIPBOARD HM CONTAINERS - DESCRIPTION AND  
SUPPLY DATA - Continued**

<b>Type</b>	<b>National Stock Number</b>	<b>Item Description</b>	<b>Applicable Specifications (DOT, Mil, Fed)</b>
Steel can lined	8110-00-128-6819	Steel, 24-gauge, 1-gal, screwcap with neoprene liner closure, epoxy resin interior lining	DOT 17C
	8100-00-400-5748	Steel, 24-gauge, 5-gal, screwcap with neoprene liner closure, epoxy resin interior lining	DOT 17C PPP-P-704 TY 1 CL4, 11
Glass carboy	8125-00-598-9380	Glass, 5-gal, wood box overpack	MIL-C-17932 TY B
Steel drum	8100-00-030-7780	Steel, 16-gauge, 55-gal, removable cover with lockring, enamel outside surface treatment	DOT 17H PPP-D-729
	8110-00-823-8121	Steel, 18-gauge, 55-gal, removable cover with lockring, enamel outside surface treatment	DOT 17H PPP-D-729
	8110-01-101-4055	Hazardous material recovery, 85-gal, open head	None
	8110-01-101-4056	Hazardous material recovery, 85-gal, open head	None
Steel drum with bung and vent	8110-00-282-2520	Steel, 5-gal, enamel exterior treatment, spout	PPP-D-704 TY 1 CL8
	8110-00-292-9738	Steel, 18-gauge, 55-gal, with bung and vent, enamel outside surface treatment	DOT 17E PPP-D-729 TY 2
	8110-00-597-2353	Steel, 16-gauge, 55-gal, with bung and vent, paint exterior surface treatment	DOT 17E PPP-D-729
Plastic liner	8115-00-145-0038	Liner, polyethylene, 5-gal, to be used with 5-gal steel drum	DOT 25 MIL-D-40030 PPP-C-00569
Plastic drum		Polyethylene, 5- or 55-gal, used to contain AFFF, reusable (see note 1)	PPP-C-1337
NOTE: 1. This type can be reused only if the drum: a. Is in good condition. b. Is triple rinsed and completely drained before reuse. c. Is properly relabeled, using the Navy HW Identification Label (S/N 0116-LF-051-0020).			

## SECTION 2.

### GENERAL STOWAGE, HANDLING, AND DISPOSAL

#### 670-2.1 STOWAGE

670-2.1.1 GENERAL. Proper Hazardous Material (HM) stowage is essential to ship and personnel safety. Supply Department and individual work center personnel are responsible for proper stowage of HM in areas under

their cognizance. For questions on HM stowage, consult the Supply Officer or HM/Hazardous Waste (HW) Coordinator. Refer to the publications cited in [Table 670-1-1](#) when more detailed information is required.

670-2.1.1.1 HM stored aboard ship are typically packaged in cases or allotments of individual containers. Personnel responsible for HM stowage shall ensure that individual containers within an HM allotment, and not just the overpacking, are labeled according to guidelines established in paragraph [670-1.9](#).

670-2.1.2 SAFETY PRECAUTIONS. Do not stow HM in heat-producing areas, or near heat-producing items. HM stowed on the weather deck or in areas exposed to the weather shall be shielded from direct sunlight.

670-2.1.2.1 Do not fill HM containers to absolute capacity. Many hazardous liquids expand when heated due to vapor release. Failure to provide expansion space may cause the container to rupture if heated.

670-2.1.2.2 Weekly monitoring of HM stowage compartments for oxygen depletion or hazardous vapor accumulations shall be conducted by the Gas Free Engineer. Unprotected shipboard personnel shall never enter a storage compartment that is suspected of containing a hazardous atmosphere. Contact the Gas Free Engineer immediately.

670-2.1.2.3 Temporary stowage of HM in work spaces shall be limited to the quantity necessary for one work shift.

670-2.1.2.4 First aid, spill response, and fire suppression equipment shall be readily available and properly maintained in HM stowage areas. Do not use an open flame to illuminate a storage compartment if shipboard lighting is inoperative.

670-2.1.2.5 To prevent blocking of permanent ventilation and fire suppression systems, do not allow overstocking in HM stowage areas. HM should be arranged athwartships within HM stowage compartments to minimize the effects of ship pitch and roll.

670-2.1.2.6 Personnel responsible for HM stowage and issue shall ensure that HM containers are kept securely stowed and tightly sealed. Incompatible HM shall be segregated according to [Section 1](#).

670-2.1.3 STOWAGE SPACES. The following guidelines pertain to the furnishings and maintenance of shipboard HM stowage areas. Because the hazards of HM and HW are similar, these guidelines are appropriate for areas where HW is stowed. Additional guidance, specific to HW stowage, is available in NSTM Chapter 593, Pollution Control .

670-2.1.3.1 Placards and Markings. Warning placards and signs in HM stowage areas notify personnel of potential dangers and caution against unsafe practices within those spaces. Warnings may be stencilled on bulkheads or printed on signs posted in areas where HM is used or stowed (see OPNAVINST 5100.19). Designated HM stowage spaces (see [Table 670-2-1](#)), lockers, chests, bins, and cabinets shall be provided with metal warning placards affixed to access doors or lids. The warning shall be painted in red letters at least 3/8-inch high on a white background, and shall identify the hazardous areas, the class of HM stowed, and any appropriate safety guidance. Placards shall be placed to ensure maximum visibility and minimum wear during normal ship operations. Sample warning placards are shown in [Figure 670-2-1](#).

**Table 670-2-1. DESIGNATED SHIPBOARD STOWAGE SPACES**

<b>HMIS Storage Codes</b>	<b>Shipboard Storage Spaces</b>
C <sub>1</sub> , C <sub>2</sub>	Acid storeroom
C <sub>1</sub>	Acid locker (organic) - special design located inside flammable liquid storeroom
C <sub>2</sub>	Acid locker (inorganic) - special design located inside flammable liquid storeroom
C <sub>1</sub> , C <sub>2</sub>	Acid locker (medical)
C <sub>2</sub>	Storage battery shop (lead acid)
B <sub>1</sub>	Bases locker (organic) - located within dry general storage
B <sub>2</sub>	Bases locker (inorganic) - located within dry general storage
B <sub>1</sub> , B <sub>2</sub>	Storage battery shop (alkaline) or aviation alkaline battery shop
F <sub>1</sub> through F <sub>6</sub>	Alcohol storeroom
	Alcohol locker
	Flammable liquid cabinet or locker
	Flammable liquid storeroom
	Flammable liquid ready service storeroom
	Flammable liquid issue room
	Aviation flammable liquid ready issue room
	Aviation paint and flammable liquid ready issue room
	Aviation flammable liquid ready issue room
	Aviation paint and flammable liquid ready issue room
	Aviation storeroom (flammables)
	Aviation storeroom (lubricants)
	Paint mixing and issue room locker
	Painting and refinishing room
	Supply department storeroom (flammable liquids)
	Supply department storeroom (aviation flammable liquids)
	Supply department storeroom (aviation lubrication oil)
	Weather deck storage area (gasoline, all types)
G <sub>1</sub> through G <sub>7</sub>	Supply department gas cylinder storeroom
G <sub>7</sub>	Supply department gas cylinder storeroom (acetylene)
G <sub>1</sub> through G <sub>2</sub>	Supply department gas cylinder storeroom (flammable)
G <sub>4</sub>	Supply department gas cylinder storeroom (CO <sub>2</sub> and Halon)
	Supply department gas cylinder storeroom (helium)
G <sub>5</sub> , G <sub>6</sub>	Supply department gas cylinder storeroom (oxygen and chlorine)
G <sub>4</sub>	Supply department gas cylinder storeroom (inert)
G <sub>4</sub> , G <sub>6</sub>	Supply department gas cylinder storeroom (oxygen and nitrogen)
G <sub>1</sub> through G <sub>7</sub>	Supply department gas cylinder storeroom (weather stowage)
C <sub>1</sub> , C <sub>2</sub>	Cargo storeroom (bulk acid and chemical)
F <sub>1</sub> through F <sub>6</sub>	Cargo storeroom (flammable liquids)
G <sub>1</sub> , G <sub>2</sub>	Cargo storeroom (flammable gas cylinders)
G <sub>4</sub>	Cargo storeroom (inert gas cylinders)
F <sub>4</sub> through F <sub>6</sub>	Cargo storeroom (lubricating oil)
L <sub>1</sub>	Cargo storeroom (dry cell battery)
S <sub>1</sub> (see note)	Cargo storeroom (medical supplies)
<b>General Storage Areas</b>	
Various codes: items stored by compatible group (including remainder of HMIS codes such as R <sub>2</sub> , J <sub>1</sub> , T <sub>3</sub> )	Supply department storerooms (bulk)

**Table 670-2-1. DESIGNATED SHIPBOARD STOWAGE SPACES -**

Continued

<b>Miscellaneous Storage Spaces</b>	
R <sub>1</sub>	Supply department calcium hypochlorite storeroom locker
F <sub>1</sub> through F <sub>6</sub> , C <sub>2</sub> , B <sub>1</sub> , B <sub>2</sub>	Cleaning gear locker/room
R <sub>1</sub>	Bromine feeder cartridge locker
T <sub>4</sub>	Mercury locker
S <sub>1</sub> (see note)	Poison antidote locker
R <sub>1</sub>	Sodium nitrate locker
S <sub>1</sub> (see note)	Medical locker
L <sub>1</sub>	Chlorate candle locker
R <sub>4</sub>	Lithium batteries locker
F <sub>1</sub> through F <sub>6</sub>	Paint locker
F <sub>1</sub> through F <sub>6</sub>	Paint storeroom
A <sub>1</sub>	Radioactive material area (according to NAVSUP Manual 485, <b>Afloat Supply Procedures</b> , and NAVSUP Manual 284, <b>Storage and Material Handling</b> )
<b>NOTES:</b> For items identified by HMIS Code S1, Multiple Hazards, proper stowage can be determined by defining the most hazardous constituent and providing the most suitable storage. Ensure that no incompatible materials are allowed to come in contact with HM. The Hierarchy will be used to present proper storage codes and criteria in the HMIS data field, and thus will refer to a specific HMIS Code that can be correlated to the proper shipboard storage location.	

670-2.1.3.1.1 Markings on bulkheads, decks, and sills identify areas of particular hazard or establish distance and space limits within an HM stowage compartment. Painted or stencilled lines can define safe distances for HM operations, stowage separation distances and safe stacking heights, proper aisle spacing, and locations of emergency equipment.

670-2.1.3.2 Housekeeping. HM stowage areas shall be well maintained to allow safe access to hazardous items, and to minimize the effects of accidents that might occur.

670-2.1.3.3 Ventilation. HM stowage spaces shall be well ventilated to prevent accumulation of toxic and flammable gases.

670-2.1.3.4 Ventilation and Temperature Alarms. Flammable liquids stowage compartments shall be fitted with circuit HF airflow alarms and circuit F high temperature alarms. The HF circuit provides audible and visual alarm signals when the ventilation system does not provide adequate airflow. The F circuit provides audible and visual alarm signals when the temperature rises above a preset level. Compartments which are fitted with circuit HF airflow alarms are identified by warning plates installed on the exterior of each compartment access door. A sample warning plate is presented in [Figure 670-2-1](#).

670-2.1.3.5 Portable Ventilation Equipment. Additional ventilation may be temporarily required in HM stowage areas if a spill occurs or when acid drums are vented. Also, some permanent ventilation systems not rated as explosion-proof may be unsafe to use when ventilating spaces where explosive fumes have been produced. In these cases, portable ventilating equipment (blowers) with explosion-proof motors may be used. Two types, each with an 8-inch diameter noncollapsible hose, are commonly used.

- a. The 0 1/2 (A or D) 1X axial-flow type. The motor is explosion-proof when assembled at the factory but may not be explosion-proof following overhaul by facilities other than Intermediate Maintenance Activities (IMA).
- b. The A-3/4 T air-turbine driven centrifugal type. It is nonelectric and designed to handle air that contains explosive vapors.

670-2.1.3.6 Security. HM/HW stowage compartments and lockers shall be secured with padlocks. A description of specific lock, hasp, and key combinations is found in NSTM Chapter 604, Locks, Keys, and Hasps .

## **670-2.2 HANDLING**

670-2.2.1 SAFETY. Improper handling of HM can harm personnel, ship systems, and marine ecology. The following criteria shall be followed in addition to the precautions outlined in [Section 1](#):

- a. In-use HM, within or in the vicinity of work spaces, shall be limited to the amount of each material used during one work shift.
- b. Access to all exits and emergency response equipment shall be kept clear at all times.

670-2.2.2 HM TRANSFERS. When transferring HM, personnel shall wear proper protective clothing, know the safety procedures for the HM and the equipment involved, and know the use and location of fire extinguishers, first aid kits, and other emergency response equipment. There shall be at least two crewmen present during HM transfer.

670-2.2.2.1 HM transfer shall occur only in assigned areas with adequate ventilation. Transfer areas shall adhere to the guidelines given in NAVSEA S9593-A7-PLN-010, Shipboard HM/HW Management Plan .

670-2.2.2.2 The following procedure shall be used during HM transfer:

1. Avoid living quarters, restricted areas, magazines, and hot work areas when transferring HM. Minimize the blocking of passageways.
2. Preserve existing labels on emptied HM containers following transfer. Label all transfer containers, unless they are used only during the transfer and then are cleaned and purged.
3. Do not leave HM unattended during transfer.
4. Use portable ventilating equipment when fixed ventilation is inadequate.
5. Regularly inspect and maintain transfer equipment.
6. Only manual hand pumps or air-driven pumps shall be used to transfer HM. Positive control of the air supply shall be assured. Drums stored horizontally shall be emptied by gravity via a self-closing spigot.
7. Containers used for transfer shall be electrically grounded with a static eliminator line or other means as described in NSTM Chapter 631, Preservation of Ships in Service (Surface Preparation and Painting) .
8. Use catch trays under all transfer points.

## **670-2.3 DISPOSAL**

670-2.3.1 GENERAL. Hazardous substances that shall be disposed of include contaminated items, items with expired shelf lives, and HM no longer needed for shipboard operations. Controlled disposal of shipboard hazardous substances is crucial for compliance with federal environmental regulations and to minimize environmental pollution. Certain HW shall never be discharged overboard. These materials require careful containerization, labeling, and stowage for eventual disposal ashore. Other HW with less damaging effects may be discharged overboard if the ship is 12 or more nautical miles from shore. Guidelines for disposal of shipboard hazardous wastes have been established in NSTM Chapter 593 . These guidelines ensure the safety of personnel and the environment and minimize the quantity of HW offloaded to shore facilities. NSTM Chapter 593 shall be consulted before HW disposal operations.

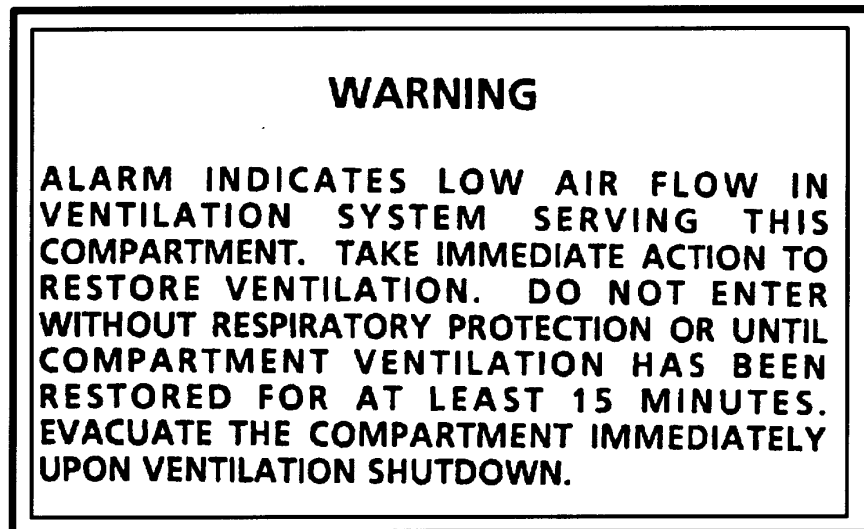
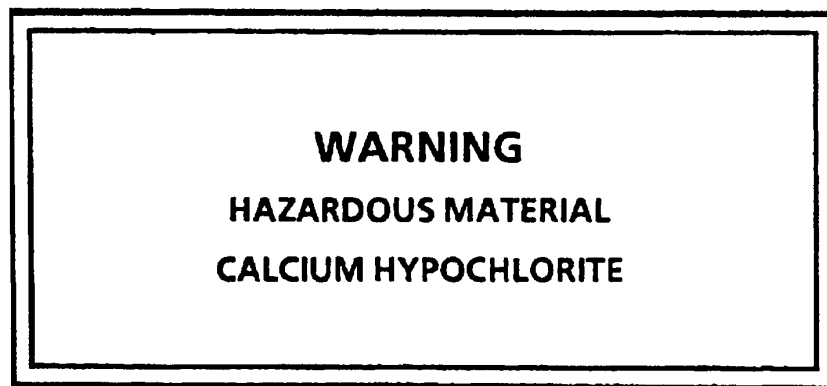
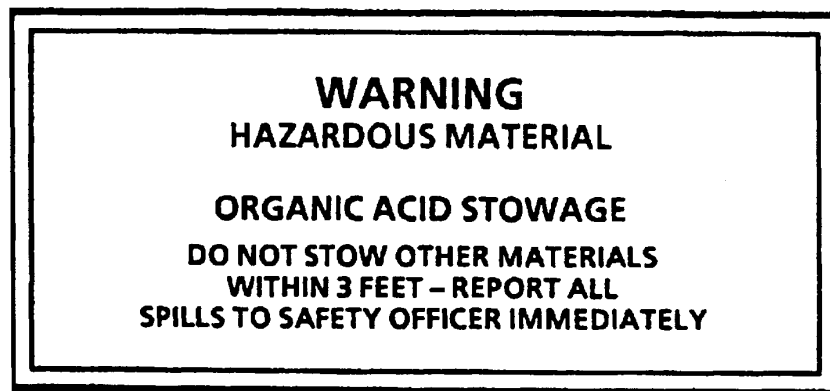


Figure 670-2-1. Sample Warning Plates

670-2.3.2 HMTIS. Hazardous Material Turned Into Store (HMTIS) is excess HM that is usable but no longer needed for shipboard operations. HMTIS shall be properly stowed aboard ship until it can be offloaded to a shoreside Supply Department. Offloading HMTIS shall be conducted according to NAVSEA S9493-A7-PLN-010, Shipboard HM/HW Management Plan .

670-2.3.3 DISPOSAL. Disposal requirements shall not prohibit the discharge of HM during emergency situations, where failure to discharge would clearly endanger the health of shipboard personnel or would risk severe damage to the ship.

670-2.3.4 OFFLOADING ASHORE FOR HMTIS AND HW DISPOSAL. All HW containers to be offloaded shall be inspected by the HM/HW Coordinator to ensure they are not damaged, corroded, or leaking, and that they are properly labeled. Labeling of HW containers shall comply with Navy Regulations described in NSTM Chapter 593 . HW shall be accurately identified to prevent excessive disposal costs.

670-2.3.4.1 Personnel shall consult their supervisor if procedures are unclear or if a hazardous condition is observed.

670-2.3.4.2 Offloads shall be scheduled with the shore activity designated to pick up the HW or HMTIS. Under no circumstances should HM/HW be left unattended on the pier.

670-2.3.4.3 Incompatible HW materials shall be segregated during storage, collection, and offloading (see paragraph [670-1.11](#)).

670-2.3.4.4 HW offloaded in Navy ports will normally be received by a Public Works Office or Center. Items designated HMTIS will normally be received by the Naval Supply Center.

670-2.3.4.5 HMTIS should not be offloaded in non-Navy or foreign ports because of the lack of processing facilities. If unavoidable, HW offloaded in non-Navy or foreign ports shall follow the procedures in NAVSEA S9593-A7-PLN-010, Shipboard HM/HW Management Plan .

670-2.3.5 OVERBOARD DISCHARGE. No HW shall be discharged 12 miles from shore or closer. Certain materials shall never be disposed of overboard; consult NSTM Chapter 593 for HW disposal guidelines.

## **SECTION 3.**

### **TOXIC MATERIALS**

#### **670-3.1 INTRODUCTION**

670-3.1.1 Toxic materials are substances which can produce personal injury through inhalation, skin absorption, or ingestion. All toxic materials shall be handled carefully to prevent injury to personnel. Many toxic materials have additional hazards, such as flammability. The general precautions of [Section 1](#) and [Section 2](#) apply. This section contains guidance for general categories of toxic materials.

## 670-3.2 CHLORINATED CLEANING SOLVENTS

670-3.2.1 HAZARDS. Chlorinated cleaning solvents are highly toxic if used improperly. The solvents are irritating to skin and toxic by ingestion. In confined spaces, spaces with inadequate ventilation, or when the vapor concentration is increased by heating, toxic vapors may cause damage to the lungs, eyes, and nervous system. Solvents decompose at high temperature to produce gases more toxic than the solvents themselves. They react with alkalies, oxidizers, and powdered metals to produce toxic gases.

670-3.2.2 RESTRICTIONS. Trichloroethane (inhibited methyl chloroform) and trichloroethylene shall not be stowed or used aboard submarines, except when authorized in Medical Department pharmacies or clinical or chemical laboratories. Trichloroethylene shall be used and stowed only on tenders and repair ships with facilities designed for its use. Tetrachloroethylene (perchloroethylene, dry cleaning solvent) is allowed only on ships with facilities for handling this solvent. Tetrachloroethane is prohibited on all ships and submarines.

670-3.2.3 STOWAGE. Do not stow near heat sources or open flames or allow contact with hot surfaces. Stowage areas shall be well ventilated and monitored regularly by the Gas Free Engineer. Do not stow near incompatible materials which include: strong alkalies such as sodium hydroxide; oxidizers such as calcium hypochlorite and sodium nitrate; or powdered metals such as aluminum.

670-3.2.4 HANDLING. Required Personnel Protective Equipment (PPE) for handling chlorinated solvents includes:

- a. Neoprene gloves
- b. Safety goggles that will protect against splashes, or a face shield
- c. Chemical cartridge respirator for organic vapors (GMA cartridge) for small amounts or for short duration; or air line or other supplied air respirator if use is extensive or in a confined space
- d. Coveralls.

670-3.2.4.1 Use chlorinated cleaning solvents only for authorized applications. Do not use near heated surfaces or open flames because of the toxic byproducts of heating. Areas where these solvents are handled shall be well ventilated. For enclosed spaces, an air change every 3 minutes is recommended. Consult the Gas Free Engineer or NSTM Chapter 074, Volume 3, Gas Free Engineering , to determine if ventilation is adequate.

670-3.2.4.2 Do not eat, drink, or smoke in areas where chlorinated cleaning solvents are handled. Do not use near, or allow them to contact, alkalies, oxidizers, or powdered metals.

670-3.2.4.3 For small spills, wear gloves, wipe up the spill, and wash down drain. For large spills, evacuate the area, and wear supplied air respiratory protection, such as Oxygen Breathing Apparatus (OBA), and protective clothing. Use absorbent material to collect the liquid, place in containers, and flush the area with water.

670-3.2.4.4 If eye or skin contact occurs, flood the affected area with water for 15 minutes. If inhalation occurs, remove the victim to fresh air, keep warm and quiet, and immediately call for medical assistance.

670-3.2.5 DISPOSAL. Containerize and keep onboard for disposal ashore. Keep separate from nonchlorinated solvents and other materials.

### 670-3.3 ORGANIC CLEANING SOLVENTS

670-3.3.1 HAZARDS. This category includes toluene, xylene, some alcohols, acetone, methyl ethyl ketone, ethyl acetate, dry cleaning solvent (PD-680 Type II), kerosene, petroleum ether, turpentine, morpholine, and other related compounds. These compounds are highly flammable, and highly to moderately toxic. Some are also corrosive. Inhalation of concentrated vapors may cause dizziness, nausea, or vomiting.

670-3.3.2 STOWAGE. Stow in the flammable liquid storeroom, ready service storeroom, or flammable liquid lockers (NAVSEA dwg 803-5000995), according to [Section 4](#). Do not stow near heat, open flames, or spark-producing devices. Stow segregated from oxidizers, such as calcium hypochlorite, sodium nitrate, and hydrogen peroxide.

670-3.3.2.1 Cleaning rags and scrapings soaked with these solvents shall be stowed in tightly sealed, metal containers which have not previously contained incompatible substances. Stow with other flammable waste for shore disposal. Label containers as follows: CONTAINS FLAMMABLE WASTE, KEEP FIRE AWAY, NO OXIDIZING MATERIALS .

670-3.3.3 HANDLING. Personnel shall consider the toxic effects and flammability of organic solvents when handling these materials. Wear neoprene gloves and safety splash goggles when handling. Protective coveralls are recommended. If vapors accumulate over 100 ppm (consult the Gas Free Engineer), an OBA or other supplied air respirator should be worn.

670-3.3.3.1 Do not use organic solvents near open flames or heated surfaces. No smoking is allowed where organic solvents are being used. Handling areas shall be well ventilated to prevent accumulation of toxic vapors. Consult the Gas Free Engineer or the Safety Officer for guidance.

670-3.3.3.2 Do not use where these solvents might contact oxidizing materials. If a spill occurs, collect the solvent with an absorbent, such as vermiculite or diatomaceous earth, then flush the area with water. If vapors accumulate, evacuate the area. Provide clean-up personnel with adequate respiratory protection and other PPE. If solvent contacts skin or eyes, flush skin or eyes immediately with water. In case of inhalation, move the person to fresh air and obtain medical attention.

### 670-3.4 FLUOROCARBON REFRIGERANTS AND SOLVENTS

670-3.4.1 GENERAL. Fluorocarbon refrigerants, such as dichlorodifluoromethane (Freon 12, Genetron 12, R-12), and fluorocarbon solvents such as trichlorotrifluoroethane (Freon 113, Freon TF, Genetron 113, R113), are commonly found aboard ship. They are used in food storage compartments and air-conditioning spaces, and as solvents in engineering spaces.

670-3.4.2 HAZARDS. When exposed to the atmosphere, fluorocarbon vapors will accumulate in low places unless local ventilation is provided. These vapors are heavier than air and can displace oxygen. Inhalation of vapors at high concentrations (4,500 ppm or greater) will cause dizziness or narcosis, or suffocation due to displacement of oxygen. The vapors are colorless and almost odorless; they cannot be detected without special instruments. Fluorocarbon refrigerants and solvents are nonflammable and nonexplosive, but exposure to flames or hot surfaces will cause these compounds to generate hydrogen chloride, hydrogen fluoride, and other poisonous gases. Fluorocarbons are not irritating, but contact may cause frostbite.

670-3.4.3 STOWAGE. Stowage areas shall be well ventilated and include low-level intakes. Freons must not be stowed in heat-producing areas, such as machinery spaces, or near heated surfaces, such as steam pipes. Smoking is not allowed in Freon stowage areas. Freon stowage compartments shall be monitored weekly by the Gas Free Engineer.

670-3.4.3.1 Personnel shall not enter a Freon stowage compartment where the ventilation has been off. The compartment shall be ventilated for at least 15 minutes and the atmosphere tested by the Gas Free Engineer (using an organic halide/oxygen analyzer). Suitable respiratory protective equipment shall be available immediately outside the stowage area.

670-3.4.3.2 Keep Freons segregated from chemically active metals such as sodium, magnesium, potassium, zinc, and powdered aluminum.

670-3.4.4 HANDLING. Do not use Freons in areas with open flames or heated interiors. Local ventilation shall be provided to keep vapor concentrations below 1,000 ppm. If fluorocarbon vapors have accumulated in a space, do not enter until it has been ventilated for at least 15 minutes and tested by the Gas Free Engineer.

670-3.4.4.1 To prevent skin and eye contact, rubber gloves, safety goggles, and protective clothing should be worn by personnel handling fluorocarbon solvents or refrigerants. An air line respirator or OBA is required if Freon vapor concentrations exceed 1,000 ppm. Refer to [Section 1](#) for guidance on PPE.

670-3.4.4.2 If a spill occurs, vapor concentrations may reach toxic levels in a very short time. Evacuate the space, provide local ventilation, and obtain the assistance of the Gas Free Engineer or Safety Officer. Clean-up personnel shall wear an OBA and PPE. For small spills, evacuation may not be necessary but respiratory protection is advisable. Protective clothing to prevent contact with the fluid is required. Absorbents such as sand, vermiculite, or diatomaceous earth should be used to remove spilled fluorocarbon fluids.

670-3.4.4.3 If eye contact occurs, immediately flush eyes with water for 15 minutes. If skin contact occurs, flush the affected skin area with warm water. If fluorocarbons are inhaled, affected personnel shall be promptly moved to fresh air, and medical assistance obtained.

670-3.4.5 TRICHLOROTRIFLUOROETHANE SOLVENT, MIL-C-81302. Operations involving trichlorotrifluoroethane (MIL-C-81302 or Freon-113) are considered hazardous operations. Operations involving this compound shall be evaluated and approved by an Industrial Hygienist or Gas Free Engineer to ensure that safety requirements are incorporated in the work process.

670-3.4.5.1 General. MIL-C-81302 is a heavy, colorless liquid at room temperature. It has a mild ethereal odor (smells like ether or dry cleaning fluid such as tetrachloroethylene). It has a low boiling point and evaporates rapidly at room temperature. MIL-C-81302 vapor is several times heavier than air and tends to collect in low places in quiet air.

670-3.4.5.1.1 The solvent is nonflammable but exposure to flames or high temperatures, such as in space heater and welding operations, causes decomposition. This decomposition produces hydrogen fluoride, hydrogen chloride, and, if water or other oxygen source is present, a small amount of phosgene. All of these compounds are toxic. Hydrogen fluoride and hydrogen chloride are very irritating, have a sharp odor, and can be detected at con-

centrations below the toxic levels. MIL-C-81302 will also react with some alkalies and certain reactive metals (sodium, potassium, powdered aluminum, and magnesium).

670-3.4.5.1.2 Exposure to MIL-C-81302 can cause headache, rapid heart beat, light-headedness, and tingling of fingers or toes. Any of these symptoms is a warning to leave the area immediately. In higher concentrations, the solvent is anesthetic (causing incoordination such as stumbling) and can cause tremors, convulsions, and death. The limit for continuous exposure (8 hours per day) to the vapors of MIL-C-81302 is 1,000 parts of solvent per million parts of air (1,000 ppm). This limit will be reached by evaporation of approximately 100 milliliters (less than 1/2 cup) of solvent in a 3 by 3 by 3 meter (10 by 10 by 10 ft) space.

670-3.4.5.2 Safety Precautions. At least two persons familiar with the properties of the solvent shall be present at all times while the solvent is being used in quantities exceeding 200 milliliters (1 cup or 1/2 pint) or while a system containing the solvent is being serviced or repaired. Do not leave the area unattended while the work is in progress unless emergency evacuation is required.

670-3.4.5.2.1 Spaces through which lines carrying MIL-C-81302 pass, need not be continuously monitored. Such spaces shall be monitored while work is in progress, according to accepted gas free engineering procedures and requirements.

670-3.4.5.2.2 Personnel who handle fluorocarbon compounds or may be exposed to these compounds in the course of their regular work (such as those who repair or service equipment containing fluorocarbons) shall be screened by the Medical Department for a history of medical conditions (such as cardiovascular disease) which might place the person at increased risk.

670-3.4.5.2.3 Chemical safety goggles or a face shield should be used while handling the solvent. MIL-C-81302 may cause irritation if splashed into the eyes. Should this occur, immediately flush the eyes with water for at least 15 minutes and obtain medical attention.

670-3.4.5.2.4 Since this solvent dissolves natural skin oils, it may lead to skin cracking and irritation. Prolonged contact should be avoided. Wear neoprene or polyvinyl alcohol gloves if contact with the solvent cannot be otherwise prevented. Clothing that becomes wet with solvent should be removed and laundered before reuse.

670-3.4.5.2.5 Be sure ventilation in the space is adequate to keep the concentration of MIL-C-81302 below 1,000 ppm of air during anticipated operations. If necessary, use portable blowers. Exhaust ventilation is preferable to blowing air into the space.

670-3.4.5.2.6 When solvent is being transferred by hose or pipe from a remote location, telephone or radio communication shall be established and maintained between the pumping station and the space where the solvent is being pumped.

670-3.4.5.2.7 To permit escape should an accidental spill occur, an emergency escape breathing apparatus shall be immediately available to each person in any space where operations involving MIL-C-81302 are taking place and in occupied spaces where MIL-C-81302 leaks may occur while systems containing fluorocarbons are being cleaned, tested, serviced, or repaired. Each person shall have received instruction and practice in the use of the particular breathing apparatus to be used. When a spill occurs, a high concentration of solvent vapor may rapidly fill the space and dilute the air in the space. Breathing this diluted air does not provide enough oxygen and loss

of consciousness can result within 10 to 15 seconds. It is therefore necessary to stop breathing until the breathing apparatus has been put on and is supplying air or oxygen. The Navy Emergency Escape Breathing Device (EEBD) is the most suitable breathing apparatus for emergency escape from a MIL-C-81302 spill.

670-3.4.5.2.8 The following exception is permitted. Aboard ship during overhaul in a shipyard, no EEBD is required for individuals in spaces where the lines being flushed or tested (except for pressure tests) with fluorocarbons contain only welded joints (no flanges, valves, or other fittings).

670-3.4.5.2.9 Smoking is prohibited in areas where MIL-C-81302 or other fluorocarbons are being used. Hot work in the space shall be suspended before using MIL-C-81302 because of the toxic decomposition products from heating. If exposed to these decomposition products, personnel shall be referred to the Medical Department for observation, as immediate or delayed pulmonary edema may occur.

670-3.4.5.2.10 The following exception is permitted. Aboard ship during overhaul in a shipyard, hot work may be performed while systems are being flushed with fluorocarbon compounds only when each operation involving hot work is authorized by a Gas Free Engineer and everyone is instructed to stop hot work and leave the area if anyone detects a sharp, stringent odor or notices any eye, nose, or throat irritation. A caution sign shall be posted in the area where MIL-C-81302 is used, and at all entrances to the area. The sign shall read: CAUTION: FLUOROCARBON (FREON) OPERATION - DO NOT ENTER UNOCCUPIED SPACE WITHOUT FIRST TESTING FOR FLUOROCARBONS. NO HOT WORK ALLOWED IN THIS SPACE EXCEPT WHEN AUTHORIZED BY A GAS FREE ENGINEER. LEAVE SPACE IMMEDIATELY IF FLUOROCARBON DETECTOR ALARMS OR ANYONE DETECTS A SHARP, STRINGENT ODOR OR NOTICES ANY EYE, NOSE, OR THROAT IRRITATION .

670-3.4.5.2.11 Carefully check the entire flushing system (including test equipment and equipment for solvent transfer) for leaks before pumping solvent through the system. A pressure drop test (75 lb/in<sup>2</sup> for 15 minutes, or lower pressure if design pressure of the equipment is lower) will reveal leaks in the system. Do not exceed design pressure.

670-3.4.5.2.12 A halide monitor with alarm (or equivalent) shall be used to continuously monitor the atmosphere in the spaces where this solvent is used. The concentration of MIL-C-81302 shall not be allowed to exceed 1,000 ppm. If the alarm sounds, personnel shall leave the space immediately and notify Damage Control Central.

### **CAUTION**

**To avoid exposure to excessive amounts of toxic gases, use the Torch Flame Halide Detector with care.**

670-3.4.5.2.13 The Fluorocarbon Monitor, Model S-25237, made by the Foxboro Company and modified by them for industrial use, has been used successfully in shipyards. A less expensive electronic halide detector with alarm added is available from Gas Tech, Inc. The General Electric H-10A Refrigerant Leak Detector will not measure fluorocarbons, but will detect their presence (sensitive to a leak of 1/2-ounce per year). In an emergency, a Torch Flame Halide Detector will also show the presence of a halide (open flame turns from normal blue to green).

670-3.4.5.2.14 When returning to the space to locate the source of the vapors, wear an SCBA capable of supplying air for at least 30 minutes, operated in a pressure-demand mode. An MSA air mask, Model 401, SCBA or equivalent is recommended. A Scott Respirator P/N 900055-52 (a full facepiece pressure demand respirator) may be used.

670-3.4.5.2.15 A caution sign shall be posted in the area where MIL-C-81302 is being used and at all entrances to the area. The sign shall read: CAUTION: NO OPEN FLAMES. DO NOT ENTER UNOCCUPIED SPACE WITHOUT TESTING THE AIR FOR FLUOROCARBONS . The sign letters shall be at least 1-inch high.

670-3.4.5.2.16 Emergency rescue procedures shall be established and proficiency documented to ensure that personnel can be safely removed from potentially hazardous spaces. Casualty instructions shall be issued directing evacuation of personnel, should a fluorocarbon accident occur. Provisions shall be made to provide continuous respiratory protection to all must-stand watch station personnel. Sufficient SCBA's shall be available to maintain continuous watch in the event other respiratory protection fails.

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**WARNING**

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**Since fluorocarbons cause cardiac sensitization, attending medical personnel shall not administer epinephrine or other heart stimulants, as heart arrhythmias, including ventricular fibrillation, may result. The patient shall be removed to fresh air immediately and not be allowed to exert himself.**

670-3.4.5.2.17 If someone is affected by MIL-C-81302 vapor, the person shall be removed from the space immediately and given artificial resuscitation if breathing has stopped.

670-3.4.5.2.18 When drying out a system with warm air or nitrogen, the drying gas shall be vented to the outside at a location where the vapors will not re-enter the ship or space.

670-3.4.5.2.19 If any MIL-C-81302 has been spilled during the cleaning or flushing operation, the bilge shall be pumped and flushed with warm water, 55° C (131° F) or higher, or the solvent absorbed with a suitable absorbent medium. Maintain ventilation until flushing is complete and bilge is free of solvent vapor.

670-3.4.5.2.20 Operations involving more than 1 cup (1/2 pint) of a fluorocarbon compound shall be monitored by a person familiar with the properties of fluorocarbons and safe handling procedures. This person shall have been trained by or under the supervision of an Industrial Hygienist or Gas Free Engineer. An Industrial Hygienist or Gas Free Engineer shall audit the operation to ensure that the required safety procedures are followed.

670-3.4.5.2.21 Personnel who handle fluorocarbons shall have received training on the properties, health effects, hazards, symptoms of overexposure, emergency response procedures, and requirements for safe handling of these compounds.

670-3.4.5.2.22 The Commanding Officer or designated representative and the Engineering Duty Officer shall be informed about flushing, cleaning, charging, or testing evolutions involving MIL-C-81302. The Commanding Officer or his designated representative shall approve the evolution before work is started.

670-3.4.5.3 Administrative Procedures. The Gas Free Engineer shall review and approve all planned operations and procedures involving fluorocarbon compounds. If leaks or spills in excess of 1/2 cup occur during cleaning and flushing operations, evacuate the space immediately and report the incident to the Officer-of-the-Deck and Damage Control Central.

670-3.4.5.3.1 These requirements and precautions apply to all operations where MIL-C-81302 is used. Hazards will differ with circumstances of use. The amount of a fluorocarbon needed to produce a toxic atmosphere depends on the size of the space. Manual cleaning of enclosed tanks is an example of a task that is potentially hazardous even when only 1/2-pint quantities of solvent are used. One gallon or more might be required to contaminate a typical submarine compartment to a toxic level. Therefore, judgement and discretion shall be used in adapting the safety precautions to specific operations.

670-3.4.5.3.2 Special conditions shall be evaluated and documented, on a case by case basis, by persons competent and responsible for doing so, before exceptions to handling precautions are permitted. Situations where a ship is unable to apply the safety and health precautions shall be documented and reported to the Naval Sea Systems Command (NAVSEA).

670-3.4.6 DISPOSAL. Containerize for shore disposal and keep separate from other solvents and materials.

## **670-3.5 MERCURY AND MERCURY COMPOUNDS**

670-3.5.1 HAZARDS. Mercury is common aboard ships as elemental mercury and as organic or inorganic mercury compounds. Mercury is an extreme health hazard and shall be stowed and handled with great caution according to NAVSEAINST 5100.3. Mercury and dry mercury batteries (except those in watches and cameras) are not to be used or stowed on submarines.

670-3.5.1.1 When exposed to air, mercury releases vapors in toxic concentrations. Inhalation, ingestion, or absorption through the skin can damage the central nervous system. Repeated exposure to low concentrations causes chronic poisoning and cumulative damage.

670-3.5.1.1.1 Mercury is corrosive to most metals except iron and platinum. Aluminum-hulled ships shall not store or carry mercury. A spill can cause cracking of the aluminum. Components containing mercury include fluorescent lighting fixtures, mercury batteries, and permanently installed instruments, sensors, and controls. Care shall be taken to avoid contact of mercury compounds with metals. Other incompatible substances are acetylenes and ammonia.

670-3.5.2 STOWAGE. Stowage shall be according to NAVSEAINST 5100.3. Stowage shall be in lockers conforming to NAVSEA dwg 803-5184175. The lockers shall be located in designated controlled mercury handling areas.

670-3.5.2.1 Stowage shall be in plastic bottles or plastic-lined glass bottles with tight stoppers or caps. The original containers shall be used whenever possible. Containers shall be inspected regularly for leaks. Stowage spaces shall be kept cool, dry, and well ventilated.

670-3.5.2.2 Mercury shall be segregated from nonferrous metals (such as aluminum, copper, brass, bronze), acetylene, acetylene products, and ammonia.

**670-3.5.3 HANDLING.** Personnel handling mercury or mercury compounds observe general precautions for HM and special stowage precautions. Mercury shall be handled only in specified areas (see NAVSEAINST 5100.3). These areas shall be kept free from excessive heat since heating of mercury liberates toxic fumes. No food, drinks, or smoking is allowed in areas where mercury is handled.

**670-3.5.3.1** Local ventilation shall be sufficient to keep the air concentration of mercury below  $0.1 \text{ mg/m}^3$  and shall provide five to ten air changes per hour. The Gas Free Engineer should be consulted to test the adequacy of ventilation.

**670-3.5.3.2** Never place or dispose of mercury in containers made of nonferrous metals (such as aluminum, copper, brass, and bronze). Do not use mercury near acetylene or ammonia.

**670-3.5.3.3** A neoprene splash suit, apron, or coveralls, neoprene gloves, and rubber-soled shoes or rubber boots shall be worn when handling mercury or its compounds. A full-face chemical cartridge respirator with a canister containing iodine-impregnated charcoal shall be worn if the mercury vapor concentration exceeds  $0.1 \text{ mg/m}^3$ . A supplied air respirator or OBA shall be worn if the concentration exceeds  $5.0 \text{ mg/m}^3$ .

**670-3.5.3.4** If 2 ounces or less of metallic mercury is spilled, apply effective local ventilation to the immediate areas of the spill. Direct ventilation overboard, and keep the area as cool as possible. Wear protective clothing at all times. Gather the mercury by sweeping or brushing, or by vacuuming with a special vacuum cleaner (MER-VAC No. 9003, available from Scott Aviation Products, 1201 Kalamazoo Street, South Haven, Michigan). Final traces of mercury will adhere to masking tape, which should be used to clean up fine globules.

**670-3.5.3.5** All material collected should be sealed in plastic bags and retained for shore disposal. The area of the spill should be washed with a solution of HgX Mercury Decontaminate (NSN 6850-00-664-2008 or 6850-00-775-3704). The solution (1.5 pounds of HgX per 5 gallons of water) should be applied dry and swabbed into deck crevices or cracks.

**670-3.5.3.6** If more than 2 ounces of metallic mercury are spilled and extensive clean-up procedures are required, an Industrial Hygienist should be consulted immediately to determine the need for protective clothing and mechanical ventilation, and to determine atmospheric mercury concentrations and related personnel exposure hazards. If an Industrial Hygienist is unavailable, the On-Scene Commander (OSCDR) or Safety Officer should supervise clean up.

**670-3.5.3.7** In the event of contact with the eyes, flush with water for 15 minutes. In case of skin contact, wash thoroughly with soap and water. If inhalation occurs, move the victim to fresh air, keep warm and at rest, and get medical assistance as soon as possible. In case of ingestion, consult a doctor immediately. Personnel who handle mercury or are exposed to it shall be included in the ship's medical surveillance program.

**670-3.5.4 DISPOSAL.** Mercury or mercury-containing compounds, waste, or water shall not be dumped into any body of water. Waste shall be packaged in double plastic bags, sealable drums, or polyethylene bottles and labeled according to NAVSEAINST 5100.3. Disposal shall be ashore in authorized disposal areas.

### 670-3.6 POLYCHLORINATED BIPHENYLS (PCB's)

670-3.6.1 DEFINITION. PCB's are chlorinated hydrocarbons used primarily as insulation in electrical equipment. They are usually white solids or colorless to pale yellow liquids, and are typically used with a solvent such as trichlorobenzene or kerosene. Refer to NSTM Chapter 593, Pollution Control , and NAVSEA S9593-A1-MAN-010, Shipboard Management Guide for Polychlorinated Biphenyls (PCB's) for additional shipboard PCB's management requirements.

670-3.6.2 HAZARDS. PCB's are highly toxic by inhalation, skin absorption, or ingestion, and are suspect carcinogens (cancer-causing agents). Repeated or prolonged exposure may cause serious health effects. The solvents used with PCB's tend to be flammable. Some PCB's vaporize easier than others therefore the inhalation risk varies. Most shipboard PCB's are enclosed in transformers and other equipment, but damage, corrosion, or improper handling may release PCB's.

670-3.6.3 STOWAGE. All stowed containers or articles containing PCB's shall have an Environmental Protection Agency-approved PCB label affixed. Consult the Medical Officer before stowing PCB items. Stow in areas away from high temperatures and open flames. Burning of PCB's releases highly toxic fumes, such as hydrogen chloride gas.

670-3.6.3.1 Strong oxidizers and corrosives are incompatible materials and shall be kept segregated. They may corrode containers and cause leakage of PCB's. Contact of these materials with PCB's may result in fire, explosion, or generation of toxic fumes. Leaking PCB items shall immediately be packed into a larger container with absorbent filler material, or transferred to a new container. Personnel handling leaking PCB items shall wear appropriate protective clothing.

670-3.6.4 HANDLING. PCB's are restricted from areas with high temperatures or open flames. Areas where PCB items are inspected, sampled, or repacked should be ventilated to at least 6 air volume changes per hour. Portable ventilation may be required.

670-3.6.4.1 PCB's shall not be used near strong oxidizers or corrosive materials. These are incompatible materials and may cause fires or release of toxic fumes.

670-3.6.4.2 PPE is required to prevent PCB's from contacting skin, eyes, and lungs. Required PPE includes:

- a. Coveralls: disposable Saranex, laminated Tyvek, or toxicological coveralls NSN 9D-8415-00-099-962/68/70
- b. Gloves: butyl rubber, neoprene, nitrile, or NSN 9D-8415-00-753-655 1/2/3/4
- c. Boots: butyl rubber, neoprene, or nitrile
- d. Respiratory protection: for testing in poorly ventilated spaces, full facepiece chemical cartridge respirator with organic vapor and pesticide cartridge and a high-efficiency carbon filter. For spill response, two kinds of respirators are suitable. A full facepiece, supplied-air respirator in combination with an auxiliary self-contained air supply will provide sufficient protection during sampling and spill response and clean-up. Equipment such as the Scott P/N 900055-52 unit or equivalent is recommended. Also recommended is a self-contained breathing apparatus (SCBA) with a full facepiece, such as the Scott Air Pac (TM) or equivalent. In either case, the respirator shall operate in the pressure-demand or other positive pressure mode. The respirators shall meet

National Institute for Occupational Safety and Health, Mine Safety and Health Administration (NIOSH/MSHA) approval. Navy OBA is not NIOSH approved and will not provide respiratory protection.

670-3.6.4.3 In the event of a spill, immediately close all floor drains and stop the discharge by repositioning the container, overpacking, or patching the leak with an epoxy or fiberglass patch kit. Ventilate directly overboard, away from air intakes, with a movable inlet and flexible hose positioned to draw contaminants away from workers. Absorb the spill with an absorbent such as Safestep (NSN 7930-01-145-5797), rags, or sponges. Decontaminate nondisposable items by applying a light spray of an appropriate solvent (such as kerosene or 1, 1, 1-trichloroethane) and absorbing the residue. Store spent absorbents and decontaminants in an approved waste container with a PCB label.

670-3.6.4.4 If PCB's contact the skin or eyes, irrigate eyes with water for 15 minutes or wash the affected skin area with soap and water for 15 minutes. Immediately call for medical assistance. Contaminated clothing should be removed quickly. If concentrated PCB vapors or fumes from burning of PCB's are inhaled, move the victim to fresh air immediately, and keep warm and quiet.

670-3.6.5 DISPOSAL. Pack no longer used or leaking PCB items with absorbent material in tightly sealed, lined-steel containers for shore disposal. Label clearly and store in well ventilated areas.

## **670-3.7 ORGANIC METALLIC CHEMICAL SALTS**

670-3.7.1 HAZARDS. Organic metallic salts include cobaltous acetate, lead acetate, potassium sodium tartrate, sodium acetate, and sodium citrate. They can be highly toxic to personnel and to the marine environment. These salts are water-absorbing and must be kept in tightly closed containers.

670-3.7.2 STOWAGE. Inspect containers of organic metallic salts periodically for bulges, leaks, and corrosion. Keep containers tightly closed when stowed to prevent absorption of water.

670-3.7.3 HANDLING. Keep containers tightly closed in between use. Avoid eye or skin contact by wearing protective gloves and goggles. Avoid inhalation of dusts, sprays, or mist. A dust, spray, and fume cartridge gas mask is required for prolonged use or when handling large quantities of these materials. In case of eye or skin contact, flush the area thoroughly with water and get medical assistance. Sweep up spills and flush residue with water.

## **670-3.8 IRRITANTS**

670-3.8.1 HAZARDS. An irritant is a substance which, immediately or on prolonged or repeated contact with normal living tissue, will cause a local irritation. The irritation may be slight, moderate, or severe. A sensitizer is an irritant that causes a greater than normal inflammatory response, due to a person's hypersensitivity. This allergic reaction becomes evident on repeated exposure to the same substance.

670-3.8.2 STOWAGE. Materials known to be irritants or sensitizers require no special stowage other than that required by their other properties, such as flammability or toxicity.

670-3.8.3 HANDLING. Personnel handling irritants should use protective gloves, barrier creams, or both. If the material produces irritating fumes, goggles and respiratory protection may be required. After contact with an

irritant, skin should be washed thoroughly with soap and water. Personnel known to be allergic to potentially irritating materials should avoid contact, and consult medical personnel if necessary.

## **SECTION 4.**

### **FLAMMABLE AND COMBUSTIBLE MATERIALS**

#### **670-4.1 DEFINITION**

670-4.1.1 Flammables and combustibles are defined in paragraph [670-1.2.1](#).

#### **670-4.2 HAZARDS**

670-4.2.1 CATEGORY I FLAMMABLES AND COMBUSTIBLES. Materials with flashpoint below 200°F are fire hazards because they produce ignitable vapors at low temperatures, often at normal room temperatures (below 100°F). Specific hazards are listed in paragraph [670-4.7.2](#).

670-4.2.2 CATEGORY II COMBUSTIBLES. These materials are major fire hazards because they can be easily ignited by fire or enemy action. They can spread fire rapidly by the flow of flaming liquids or through explosions. Most of the materials designated in Category II are petroleum products.

#### **670-4.3 STOWAGE**

670-4.3.1 GENERAL. Stowage location requirements for flammable and combustible materials are summarized in [Table 670-4-2](#). The stowage requirements contained in the following paragraphs shall be observed.

670-4.3.1.1 Open flames are not allowed in flammable liquid storerooms, issue rooms, ready service storerooms (such as the paint mix and issue room), or in the vicinity of flammable material cabinets. Smoking is prohibited in these spaces and within 15 feet of flammable material cabinets.

670-4.3.1.2 Flammable and combustible materials shall be stowed separately from oxidizing materials.

670-4.3.1.3 Personnel responsible for stowage of flammable and combustible materials should be familiar with fire prevention and safe handling procedures.

670-4.3.1.4 Materials stored in the flammable liquid storeroom (except alcohols) shall be unpacked before stowage. The packaging materials shall be removed from the storeroom immediately. Materials shall be stowed to minimize risk of spills or breakage. Individual containers shall have either the Department of Transportation (DOT) or National Fire Protection Association (NFPA) label identifying them as flammable or combustible.

670-4.3.1.5 Partially used materials returned to stowage facilities shall be tightly closed and properly labeled. Inventory lists of flammable and combustible materials in stowage facilities shall be maintained. Materials in corroded or leaking containers shall be transferred to new containers and labeled, and the old container shall be properly disposed of.

670-4.3.1.6 During strip ship condition, all unnecessary flammables and combustibles shall be offloaded. Those necessary for the ship's operation shall be removed from in-use stowage facilities and placed in the ship's flammable liquids storeroom.

670-4.3.2 **FLAMMABLE AND COMBUSTIBLE MATERIAL CABINETS.** The cabinets shall be approved by NAVSEA. Approved cabinets shall meet the requirements of National Fire Protection Association (NFPA) Code 30, meet Grade B shock requirements per military specification MIL-S-901, and have self-closing doors. Commercial cabinets which have been approved for surface ships by COMNAVSEASYS COM Code 03H are included in [Table 670-4-1](#).

**Table 670-4-1. NAVSEA-APPROVED COMMERCIAL CABINETS**

MANUFACTURER	MODEL	CAPACITY	WEIGHT	DIMENSIONS (approx)
Delta	CSL 10	10 gal	125 lb	20"W x 20"D x 36"H
Delta	CSL 15	15 gal	145 lb	20"W x 20"D x 46"H
Justrite	25040N	4 gal	78 lb	17"W x 17"D x 22"H
Justrite	25710N	12 gal	99 lb	23.5"W x 18"D x 35.25"H
Justrite	25315N	15 gal	126 lb	23.5"W x 18"D x 44.25"H
Protectoseal	5514S	4 gal	86 lb	19.94"W x 18.13"D x 17.07"H
Protectoseal	5514S	6 gal	86 lb	19.94"W x 18.13"D x 17.07"H
Protectoseal	5517S	10 gal	121 lb	19.94"W x 18.13"D x 35.07"H
Protectoseal	5517S	12 gal	121 lb	19.94"W x 18.13"D x 35.07"H
Protectoseal	5517S	15 gal	121 lb	19.94"W x 18.13"D x 35.07"H

670-4.3.2.1 **Cabinet Criteria.** Cabinet color shall be yellow and distinguishable from other shipboard cabinets and lockers. The cabinet shall be fitted with a 10 inch long and 6 inch high self-adhesive vinyl placard that is green in color with white letters:

**FLAMMABLE KEEP FIRE AWAY**

For stowage for in-use flammable and combustible items only, hazardous materials information system (HIMS) Codes F1-F6; fire hazard codes of gasoline, oxidizers and acids shall not be stowed in this cabinet. NAVSEA approval is required to relocate this cabinet. This cabinet is intended for use by \_\_\_\_\_ Department(s) and Division(s) and is the responsibility of \_\_\_\_\_.

Placard blanks are to be filled in by the appropriate official aboard the ship.

**670-4.3.2.2 Surface Ship Location Restrictions.**

- a. Cabinets shall not be located in living spaces, passageways, magazines, steering gear rooms, or aircraft hangars.
- b. Cabinets shall not be located adjacent to magazines, steering gear rooms, or nontight bulkheads that are boundaries to living spaces.

- c. Cabinets shall not be installed directly under major wireways and wherever practicable, not installed under any wireway.
- d. Cabinets shall not be located in spaces that are not mechanically ventilated.
- e. No more than a total of 30 gallons shall be installed in the same compartment. The total amount stowed on a deck within a fire zone shall not exceed 180 gallons.

670-4.3.2.3 Submarine Location Restrictions. Cabinets shall not be located in living spaces, above waist-height on the highest compartment level or deck, or within 6 feet of interior hull insulation.

670-4.3.2.4 Surface Ship and Submarine Location Requirements.

- a. Cabinets shall be at least one compartment (space for submarines) removed from compartments (spaces) containing oxidizers such as oxygen-nitrogen plants and oxygen cylinder storerooms.
- b. Cabinets shall stand off from bulkheads by a minimum of six (6) inches and have an eighteen (18) inch clearance from hot surfaces, such as machinery or piping.
- c. An eighteen (18) pound capacity potassium bicarbonate (PKP) dry chemical extinguisher shall be installed in the vicinity of a cabinet or cabinets.
- d. The cabinet base shall be welded all around to deck plating or 10.2 pound plate welded sub-base on machinery room gratings.
- e. Installation shall conform to requirements of Grade B shock.
- f. Welding shall conform to NSTM Chapter 074 .

670-4.3.2.5 During strip ship condition, all necessary flammables and combustibles shall be offloaded. Those necessary for the ship's operation shall be removed from in-use stowage facilities and placed in the ship's flammable liquids storeroom. Gasoline shall remain located in approved weather storage spaces.

#### **670-4.4 CATEGORY I FLAMMABLES**

670-4.4.1 Bulk Stowage of Category I flammables shall be in flammable liquid storerooms. Gasoline (all types) stored in drums or other portable containers shall only be stored in NAVSEA approved jettisonable racks or lockers in the weather. Flammable materials for Medical Department use, including ethanol, shall be stowed in designated lockers in the medical storeroom or pharmacy

670-4.4.2 Limited in-use quantities of Category I flammables (the amount of each item used on a daily basis) may be stowed in locked flammable material issue rooms, ready service storerooms, or Naval Sea Systems Command (NAVSEA) approved flammable liquid cabinets. Cabinets in machinery spaces shall not contain Category I flammables (flashpoint below 200°F). During strip ship condition, all flammables in in-use stowage facilities shall be off-loaded or relocated to the flammable liquid storeroom.

## **670-4.5 CATEGORY II COMBUSTIBLES**

670-4.5.1 Bulk Stowage of Category I flammables shall be in flammable liquid storerooms. Gasoline (all types) stored in drums or other portable containers shall only be stored in NAVSEA approved jettisonable racks or lockers in the weather. Flammable materials for Medical Department use, including ethanol, shall be stowed in designated lockers in the medical storeroom or pharmacy.

670-4.5.2 In-use stowage of Category II combustibles shall be in flammable materials issue rooms, ready service storerooms, commercial flammable liquid cabinets, or NAVSEA-approved flammable liquid cabinets. In-use stowage is limited to one container of each item used on a daily basis. Ships lacking flammable liquid cabinets for in-use stowage are allowed to stow up to 12 gallons of Category II combustibles in work spaces within a coaming capable of containing the entire amount of material stowed. Coamings shall not be located in fire hazard areas or where ignition sources are present. During strip ship condition, combustibles within coamings shall be off-loaded or relocated to flammable liquid storerooms.

## **670-4.6 HANDLING**

670-4.6.1 Precautions for handling specific flammable and combustible materials are given in paragraphs [670-4.7.1](#) through [670-4.8.4.1](#). Paragraph [670-1.6](#) gives safety guidelines. Other sources for safe handling procedures are NSTM Chapters 541, Petroleum Fuel Stowage, Use, and Testing; 542, Gasoline and JP-5 Fuel Systems; 550, Industrial Gases; Generating, Handling, and Storage; and 631, Preservation of Ships in Service, (Surface Preparation and Painting) .

670-4.6.2 Flammable and combustible materials shall be kept away from open flames, hot work areas, or other sources of heat, and strong oxidizing materials. Smoking is not permitted in areas where flammable and combustible materials are being handled.

670-4.6.3 Containers of flammable and combustible materials shall be kept covered or sealed unless in immediate use. Materials shall be returned to flammable material stowage facilities after use. Handling areas for flammable and combustible materials shall be well ventilated to prevent accumulation of vapors. Consult the Gas Free Engineer to determine safe ventilation rates. Containers shall be protected from physical damage during handling.

670-4.6.4 Containers of flammable and combustible materials and containers used for their transfer shall be electrically grounded before transfer, as detailed in NSTM Chapter 593, Pollution Control . Rubber-soled shoes should be worn when handling flammable and combustible materials.

## **670-4.7 SPECIFIC CATEGORY I FLAMMABLES**

670-4.7.1 GENERAL. Hazards, stowage requirements, and handling precautions for specific classes of these materials are contained in the following paragraphs.

670-4.7.2 GASOLINE. Gasoline is an extremely flammable mixture of several different hydrocarbon compounds and additives.

670-4.7.2.1 Hazards. Gasoline is highly volatile even at low temperatures. The vapors are a fire hazard at all times. The flashpoint for the vapors is approximately -45°F (-43°C). The explosive range is 1.4 to 7.6 percent by volume in air. The vapors are three to five times heavier than air and will tend to sink to the lowest level of compartments when released.

670-4.7.2.1.1 Gasoline is toxic. Contact of the liquid with skin or eyes can cause severe irritation and flesh or eye burns. Inhalation of the vapors can cause depression of the central nervous system with symptoms of severe headache and dizziness. Leaded gasoline is even more toxic by both inhalation and skin absorption than unleaded gasoline.

670-4.7.2.2 Use Restrictions. Because of the extremely hazardous nature of gasoline, it shall be used only when there is no suitable alternative to meet operational requirements. Only the minimum required amount (based on the expected usage rate for each deployment) shall be carried aboard ship. Gasoline is permitted aboard ship only in support of the following essential equipment:

- a. P-250 pumps
- b. HLU-196 bomb hoists as well as crash and rescue equipment on aircraft carriers
- c. USMC, EOD, and SOF equipment which requires gasoline as a fuel
- d. Unmanned Aerial Vehicles (UAVs).

#### NOTE

A few P-250 pumps remain in service that still require gasoline as fuel. Most have been converted to JP-5. A new pump, the P-100 (JP-5 fueled) will eventually replace all P-250's.

670-4.7.2.3 Stowage. When compensated stowage tanks, according to NSTM Chapter 542 , are not available aboard ship, gasoline containers shall be stowed in the weather and located so that they may be readily jettisoned overboard in accordance with [Table 670-4-2](#). Stowage locations shall not be in the vicinity of hatches and doors, galleys, ready-service magazines, shops where hot work is performed, ventilation intakes or exhausts, or in locations where aircraft engine exhaust, missile blast, or gun blast could impinge on such storage. Stowage shall be aft, if possible, and in the location that poses the least threat to the ship in the event of fire or explosion. On air-capable ships, stowage shall not be near launching or recovery areas. Stowage locations shall be designated gasoline hazard areas according to NSTM Chapter 542 . Prior to loading aboard, the integrity of all storage containers (drums, bladders, and rigid metal or plastic cans) shall be verified. Inspect for evidence of leakage, advanced rust or deterioration. Any containers showing signs of leakage shall be rejected. Jettison racks, lockers, and release mechanisms shall be inspected and maintained in accordance with PMS. Approved containers for shipboard use are:

- a. Metal cans meeting MIL-C-1283 or safety cans meeting FED-SPEC RR-S-30.
- b. Fifty-five gallon drums meeting FED-SPEC-729, Type I, Class A.
- c. Collapsible rubberized fabric drums (bladders) meeting MIL-D-23119 or specifically approved by NAVSEA.
- d. Rigid portable fuel containers meeting 46 CFR 147.45f(4).

**WARNING**

**Containers, even when empty, will contain enough residual gasoline liquid and vapors to support ignition or explosion. They shall be treated with the same precautions as when full. Drain containers completely or until fully deflated. Replace cap or plug tightly. Store on the weatherdeck as described above. Refill containers when supplies are available or dispose of them as soon as possible.**

**Table 670-4-2. STOWAGE REQUIREMENTS FOR FLAMMABLES AND COMBUSTIBLES ABOARD SHIPS**

CATEGORY	STORAGE CODE		CHIL FIRE HAZARD CODE	FLASHPOINT	STOWAGE
	HMIS	CHIL			
I	F1	G	4	Below 200°F and all aerosols	<p>Large Quantities: Flammable Liquids Storeroom Limited In-Use</p> <p>Quantities: Flammable Liquids Issue Room, Flammable Liquids Ready Service Storeroom, or commercial flammable liquid cabinets approved by NAVSEA, meeting NFPA Code 30 requirements and Grade B shock qualified.</p> <p>Note 1: Before installation of in-use stowage facilities, Category I flammables and combustibles shall be returned to the flammable liquids storeroom after each use.</p> <p>Note 2: Category I flammables shall not be stowed in machinery spaces.</p> <p>Note 3: Gasoline (all types) shall only be stored in jettisonable racks or lockers in the weather unless otherwise approved by NAVSEA or TYCOM.</p>
	F2	G	4		
	F3	G	3		
	F4	G	2		
	F5	G	2		

**Table 670-4-2. STOWAGE REQUIREMENTS FOR FLAMMABLES AND COMBUSTIBLES ABOARD SHIPS - Continued**

CATEGORY	STORAGE CODE		CHIL FIRE HAZARD CODE	FLASHPOINT	STOWAGE
	HMIS	CHIL			
II	F6	G	1	At or above 200°F	Large Quantities: Flammable Liquids Storeroom Limited In-Use Quantities: Flammable Liquids Issue Room, Flammable Liquids Ready Service Storeroom, or commercial flammable liquid cabinets approved by NAVSEA, meeting NFPA Code 30 requirements, and Grade B shock qualified.

670-4.7.2.3.1 Interior stowage of gasoline in support of amphibious operations shall only be in fixed, dedicated, gasoline stowage systems as described in NSTM Chapter 542 . Gasoline shall not be stowed in flammable liquid stowages or other compartments.

670-4.7.2.3.2 Gas tanks for P-250 pumps shall be stowed with a foundation and cover as shown in BUSHIPS dwg 805-2482519 or in NAVSEA dwg 804-5184260 or 803-518261. Stowage of fuel within the pump cover is acceptable when the gasket and cover are properly maintained to prevent fumes from leaking out. Extra tanks shall be stowed on the weatherdeck as described in paragraph 670-4.7.2.3. Gas for HLU-196 bomb hoists and crash/rescue saws shall be stowed on the weatherdeck or in specially configured Halon-protected spaces in hangar sponsons. Locations shall be designated gasoline hazard areas according to NSTM Chapter 542 . M151 vehicles shall be stowed with gas tanks three-quarters full. Auxiliary 5-gallon MOGAS cans (MIL-C-1283) shall be designated racks with the vehicle. After operations, emptied or partially filled cans shall be refilled before being brought back aboard ship. MOGAS shall not be transferred from these cans while onboard ship.

#### NOTE

Special provisions for stowing and handling gasoline to support other USMC requirements and RPV operations shall be approved by NAVSEA for each situation.

670-4.7.2.4 Handling. Gasoline shall be handled with extreme caution according to the guidelines in NSTM Chapter 542 . Gasoline for serving authorized equipment shall be used on the weatherdecks in designated gasoline hazard areas, except for interior operations of the P-250 pump or on ships that have dedicated interior gasoline stowage and fueling stations. Specific precautions include:

- No open flames, smoking, or hot work shall be permitted when handling gasoline or in gasoline hazard areas.
- A warning plate shall be installed in a conspicuous place or placed near the access to possible gasoline hazard areas. Inscribe in red letters 1-inch high: WARNING GASOLINE HAZARD AREA. Smoking, use of

naked lights, matches or lighters, use of tools that may produce sparks, wearing of clothing or shoes with exposed metal attachments, and any other actions leading to ignition of gasoline vapors are not permitted.

- c. Ventilation shall be sufficient to prevent accumulation of fumes.
- d. Systems shall be grounded to prevent sparks from buildup of electric charges.
- e. Only personnel trained in gasoline handling procedures shall be assigned to handle gasoline or gasoline powered equipment.

670-4.7.2.4.1 Jettison Rack Safing. When in port, and as may be required for other evolutions, the jettisonable feature shall be overridden to preclude inadvertent actuation to ensure the safety of personnel on the pier or working in boats, barges, and on breasting camels alongside. When the jettison capability is overridden, the OOD and DCA shall be notified. Unauthorized personnel shall remain clear of the MOGAS stowage area. All burning or hot work restrictions within 50 feet of MOGAS storage area in all directions shall be strictly enforced.

670-4.7.2.4.2 Storage of Portable MOGAS Containers. Upon return of the landing forces, some portable containers will have varying amounts of MOGAS or MOGAS plus oil mixtures remaining. These partially filled containers shall be consolidated or refilled as mission planning requires. Dedicated drums marked "MOGAS" and "MOGAS PLUS OIL MIXTURE" can be utilized for consolidation and/or reissue. When necessary, partially filled bladders may be stowed in approved 55-gallon rigid drums and stowed on jettisonable racks until replenished or redeployed.

670-4.7.2.5 Tanks for MOGAS P-250 Mod 2 Pumps. Tanks for MOGAS P-250 Mod 2 pumps shall be stowed with a foundation and cover as shown in BUSHIPS dwg 805-2482519 or in NAVSEA dwg 804-5184260 or 803-5184261. Stowage of fuel within the pump cover is acceptable when the gasket and cover are properly maintained to prevent fumes from leaking out. Extra tanks shall be stowed in the weather as described in paragraph [670-4.7.2.3](#). Gas for HLU-196 bomb hoists and crash and rescue equipment shall be stowed on the weatherdeck or in specially configured Halon-protected spaces. Vehicles shall be stowed with gas tanks three-quarters full. Auxiliary 5-gallon MOGAS cans (MIL-C-1283) shall be stored in designated racks with the vehicle. After operations, emptied or partially filled cans shall be refilled before being brought back aboard ship, wherever possible. MOGAS shall not be transferred from these cans while onboard ship.

#### NOTE

Special provisions for stowing and handling gasoline to support other USMC and USN requirements shall be approved by NAVSEA or the TYCOM for each situation.

670-4.7.2.6 Replenishment of MOGAS Storage Containers. Onboard containerized gasoline may be replenished by either loading aboard in filled drums or by handcarrying the smaller bladders aboard. All containers must be positioned and secured on appropriate jettison racks or in lockers. Drums and 500-gallon bladders may be refilled from a source on the pier.

670-4.7.2.7 Dispensing Gasoline. All gasoline issues shall be conducted with no less than two men present. Portable fire extinguishers (PKP or AFFF) shall be readily available. Gasoline can be dispensed to other containers from drums stored both vertically and horizontally, or from an approved 500-gallon collapsible storage bladder. Hand or air operated barrel pumps can be used to transfer gasoline from vertically stowed drums or from the

500-gallon collapsible bladder. A spring-loaded, self-closing, lockable spigot shall be used to gravity fill containers from horizontally stowed drums. Refer to NSTM Chapter 542 , for gasoline-related grounding procedures.

670-4.7.2.8 Pre-Staging Filled Portable Containers. Commanding Officers or Embarked Officers-in-Charge shall determine the numbers of and timing for the filling of portable containers in preparation for deployment. The route to be taken from the replenishing or jettison stowage location to the debarkation area shall be established by the DCA or Fire Marshall. Transiting berthing and living areas shall be avoided when possible. Secure hot work and other heat or spark producing sources within 50 feet of the route to be taken prior to commencing movement. The DCA or Fire Marshall shall be notified of the planned movement of gasoline.

670-4.7.3 ALCOHOLS. Alcohols are highly flammable and vaporize easily.

670-4.7.3.1 Hazards. Denatured ethyl alcohol (a solvent for gums, varnishes, and de-icing fluids) requires special stowage. It is very toxic by ingestion and its vapors are irritating to the eyes and respiratory tract. Butyl alcohol (a solvent for protective coatings) is a slight irritant, and moderately toxic by ingestion. Methyl alcohol is moderately toxic by skin absorption, highly toxic by ingestion, and slightly irritating to eyes, respiratory tract, and skin. Isopropyl alcohol (used for cleaning and degreasing) is slightly irritating to the eyes, nose, and throat.

670-4.7.3.2 Stowage. Alcohols shall be stowed in closed containers to avoid evaporation or water absorption. The containers shall be kept in original shipping cartons or in an alcohol locker in the flammable liquids store-room. Denatured ethanol for medical purposes shall be stowed in the Medical Department flammable liquids locker.

670-4.7.3.3 Handling. Denatured ethyl alcohol shall be used as a solvent for gums, varnishes, and de-icing fluids, but shall not be used for cleaning or degreasing. For cleaning or degreasing, isopropyl alcohol shall be used. Alcohols shall never be handled near open flames or other ignition sources. Mechanical ventilation shall be provided during prolonged handling to prevent accumulation of hazardous vapors.

670-4.7.3.3.1 Personnel handling alcohols in confined spaces for cleaning operations are required to wear safety coveralls, safety goggles, rubber gloves, and a chemical cartridge respirator in conjunction with forced ventilation. In case of skin contact, wash with soap and water. In case of eye contact, flush with water for 15 minutes and obtain medical attention. Spills should be immediately flooded with water and locally ventilated to prevent accumulation of toxic vapors.

670-4.7.4 ADHESIVES. Adhesives, epoxies, and epoxy resins generally contain flammable solvents and may also be toxic.

670-4.7.4.1 Forced ventilation is required when handling adhesive resins in confined spaces or in the event of a spill. Rubber gloves and safety goggles are required when handling these compounds. Spill should be wiped up immediately and clean-up rags stored in closed metal containers. If soap and water is not adequate for clean-up, organic solvents may be used with caution.

670-4.7.5 PAINTS. Oil-based paints are flammable and may contain toxic solvents or extenders. These paints include enamels, vinyl paints, shellac, polyurethane, polyamide epoxy, cellulose nitrate coating, wash primer pretreatment, and aluminum paste paints.

670-4.7.5.1 Stowage. Stow in-use quantities of oil-based paints in the paint mix and issue rooms. Water-based paints shall not be stowed in flammable material stowage facilities.

670-4.7.5.2 Handling. Paints shall be isolated from open flames, sparks, operating electrical equipment, and other ignition sources. Application of paint to hot surfaces requires special precautions according to NSTM Chapter 631 .

670-4.7.5.2.1 Adequate ventilation according to NSTM Chapter 631 shall be provided in painting areas. In open areas with unrestricted ventilation, personnel shall use approved mechanical filter respirators to remove solid particulates from the air. Where ventilation is restricted, forced ventilation shall be added and approved chemical and mechanical filters shall be worn to remove particulates and vapors. If sufficient ventilation cannot be provided, supplied air or Self-Contained Breathing Apparatus (SCBA) shall be used.

670-4.7.5.2.2 In addition to respiratory protection, safety splash goggles, chemical resistant gloves for prolonged exposures, and protective coveralls are required. Barrier creams should be used when skin contact is likely.

670-4.7.5.2.3 Absorb spilled paints and varnishes with rags and dispose of the rags in air-tight containers.

670-4.7.6 PAINT SOLVENTS. These materials include paint strippers, paint thinners, paint driers, and naphthalene. Vapors in high concentrations may be toxic as well as flammable.

670-4.7.6.1 Use solvents only in well-ventilated areas. Enclosed areas shall have forced ventilation. Put unused quantities of solvents promptly back in the original container and return to the flammable liquids storage facility.

670-4.7.6.2 Wear air-tight safety goggles, chemical-resistant gloves, and a chemical cartridge organic vapor respirator with a dust filter. Consult the Gas Free Engineer, Medical Officer, and NSTM Chapter 631 for more information.

670-4.7.6.3 Paint strippers containing phenol or cresol (such as MIL-R-45116, MIL-R-81924, and MIL-R-81903) are considerably more toxic than other paint solvents. Both phenol and cresol are readily absorbed through skin and, if not washed off promptly, may cause serious illness or even death. Minimum personnel protection includes rubber-framed safety goggles, face shields, and solvent-resistant gloves, suits, and boots. Full eye protection with respirators or air-supplied hoods is mandatory when working in enclosed spaces or when ventilation may not be adequate to remove vapors.

670-4.7.6.4 In case of skin or eye contact, immediately flush with water and get medical assistance. Remove any contaminated clothing immediately, and launder before reuse.

670-4.7.7 CLEANING COMPOUNDS. In addition to being flammable, the solvents in many cleaning compounds are skin irritants and may emit toxic vapors. Some cleaners may contain hydrocarbon solvents described in paragraph [670-4.7.8](#). Wear organic vapor respirators, gloves, and safety goggles when handling and transferring cleaning compounds. Handle metal-cleaning compounds only in well ventilated areas away from open flames.

**670-4.7.8 HYDROCARBON SOLVENTS.** Hydrocarbon solvents including acetone, butyl acetate, dry cleaning solvent (PD-680 Type II), ethyl acetate, methyl ethyl ketone, methyl isobutyl ketone, naphtha, dope and lacquer thinner, toluene, xylene, and turpentine, are highly flammable and shall be properly stowed and handled carefully. Inhalation of high concentrations of vapors may cause acute poisoning, narcosis, and even death. Repeated exposure to low concentrations of these solvents may cause irritation of eyes, respiratory tract, and skin, or severe or fatal anemia.

**670-4.7.8.1** Handling is restricted to well ventilated areas approved by the Safety Officer or the Gas Free Engineer. Inhalation of concentrated vapors is highly toxic, and the following precautions shall be observed:

1. Do not use near flames or other ignition sources.
2. Neoprene gloves, safety splash goggles, and protective coveralls should always be worn when handling these solvents. In poorly ventilated areas or where vapors may become concentrated (above 100 ppm), an Oxygen Breathing Apparatus (OBA) or air-supplied respirator is required.
3. If a spill occurs, use rags or an absorbent such as sand or vermiculite to collect the solvent, then flush the area with water. Dispose of the rags or absorbent in closed metal containers.
4. If solvent contacts skin or eyes, immediately flush with water and obtain medical assistance. In case of inhalation, move the person to fresh air and obtain medical assistance.

#### NOTE

Aerosols shall not be stowed or used on submarines.

**670-4.7.9 AEROSOLS.** Pressurized (aerosol) dispensers are used for paints, insecticides, lubricating oils, inspection penetrant kits, rust preventives, silicones, shaving cream, and other materials. The contents are under pressure and the containers may burst if heated. Propellants are usually Category I Flammables, and in high concentrations are anesthetic and asphyxiating. Propellant contact with flames or hot metal surfaces form decomposition products that are corrosive, toxic, or irritating. Many aerosols, such as personal hygiene items, are not labeled as flammable because of varying labeling regulations. However, all aerosols are considered Category I Flammables regardless of contents and shall be stowed accordingly.

**670-4.7.9.1** Keep containers away from heat sources such as steam lines and energized electrical equipment. Avoid prolonged exposure to sunlight. Do not spray aerosols in the presence of flames, hot surfaces, or other ignition sources.

**670-4.7.9.2** Avoid contact of spray or residual liquid with eyes, skin, or clothing. Avoid inhalation of aerosol spray or vapors of the residual liquid. Avoid accumulation of toxic or flammable vapors in the air.

**670-4.7.9.3** Keep contaminated rags and clothing away from heat sources (such as light bulbs, sunlight, and steam pipes), which might cause spontaneous ignition. Do not puncture aerosol dispensers even if they have been used.

**670-4.7.10 CARBIDES AND PHOSPHIDES.** Contact of these materials (calcium carbide, calcium phosphide, and zinc phosphide) with water produces extremely flammable gases, such as acetylene and phosphine. Phosphine is also poisonous.

670-4.7.10.1 Stowage. These materials shall be protected from contact with water.

670-4.7.10.2 Handling. Because of the hazards of carbides or phosphides coming in contact with moisture, the following precautions shall be observed:

1. Handle only in dry, well ventilated areas without sprinkler protection or other sources of water.
2. Minimum personnel protection includes a chemical cartridge respirator, coveralls, safety goggles, and neoprene gloves. If forced ventilation is unavailable, a supplied air respirator shall be used.
3. In case of eye or skin contact, flush the area with water for 15 minutes, in an area away from the remainder of the material. Remove and isolate contaminated clothing.
4. In the event of a spill, keep the area free of water. Clean-up personnel shall wear a supplied air respirator, gastight goggles, neoprene gloves, and chemical-resistant splash suits. Shovel the spilled material into dry, air-tight containers. After moving containers, flush the spill area with water.

670-4.7.11 POLYMERIZABLE MATERIALS. A polymerizable material is a liquid, solid, or gas which will combine or react with itself.

670-4.7.11.1 Hazards. Acrylic base adhesives for acrylic plastics, Type I epoxy resin base component, may polymerize when exposed to fire or raised temperatures. The polymerization produces more heat, which accelerates the reaction and may cause explosive ruptures of containers. This may lead to fire conditions. These materials will also react with strong acids and alkalies. The adhesive is highly irritating to eyes, respiratory tract, and skin, and is moderately toxic by inhalation and ingestion.

670-4.7.11.2 Stowage. Keep away from strong acids and alkalies.

670-4.7.11.3 Handling. Mix batches of resins and hardeners in a back-ventilated hood to prevent escape of hazardous vapors. Segregate the work area and keep away from heat and ignition sources. Cover bench tops and work surfaces with disposable paper.

670-4.7.11.3.1 Required Personnel Protective Clothing and Equipment (PPE) includes neoprene gloves, safety goggles, protective aprons or coveralls, barrier creams, and if adequate ventilation is not available, a chemical cartridge respirator.

670-4.7.11.3.2 Wash hands before and after work and whenever resin contacts the skin. Do not add materials to the adhesive resin except for the specific catalyst provided by the manufacturer.

## **670-4.8 SPECIFIC CATEGORY II FLAMMABLES**

670-4.8.1 ANTIFREEZE SOLUTIONS. Antifreeze solutions are used in the cooling systems of liquid-cooled internal combustion engines. Solutions contain ethylene glycol, propylene glycol, or glycerol, as well as corrosion inhibitors.

670-4.8.1.1 Hazards. These materials are hygroscopic (water-absorbing) but are chemically stable if kept in their original sealed containers and are protected from freezing temperatures. Toxic exposures may result from inhalation of vapors at elevated temperatures, inhalation of mists, ingestion, or prolonged skin exposure.

670-4.8.1.2 Stowage. These materials shall be kept in their original sealed containers whenever possible, to prevent absorption of water.

670-4.8.1.3 Handling. Wear neoprene gloves and safety splash goggles while handling antifreeze solutions. In case of skin contact, wash the area thoroughly with soap and water. Spills should be wiped up immediately and the affected area flushed with water. A supplied air respirator or OBA shall be worn in the event of a spill.

670-4.8.2 CORROSION PREVENTIVE COMPOUNDS. Corrosion preventive compounds for aircraft engines or engine cooling fluids are low fire hazard materials, but may ignite if exposed to open flame or come in contact with oxidizing agents. Their components may be toxic. Keep in closed containers and segregated from oxidizers and open flames.

670-4.8.3 LUBRICANTS AND HYDRAULIC FLUIDS. This includes lube oils, greases, boiled and raw linseed oils, steam turbine oils, corrosion preventives (heavy oil and soluble oil types), and petroleum and synthetic hydraulic fluids.

670-4.8.3.1 Hazards. Many lubricants may be combustible and toxic from prolonged or repeated exposure. Excessive heating of some lubricants may produce toxic vapors or mists. Fire-resistant hydraulic fluids contain tricresyl phosphates, which may be toxic by inhalation or skin absorption, and highly toxic by ingestion. Detailed safety procedures can be found in NSTM Chapters 262, Lubricating Oils, Greases, Hydraulic Fluids, and Lubricating Systems ; and 556, Hydraulic Equipment (Power Transmission and Control) .

670-4.8.3.2 Stowage. Stowage locations for these materials shall have a sign posted to warn of possible health hazards from prolonged or repeated exposure.

670-4.8.3.3 Handling. Adequate ventilation shall be provided to keep vapors from accumulating and to remove any toxic mists produced by contact of lubricants with heated surfaces. PPE includes a neoprene or polyethylene splash suit or coveralls, rubber gloves, safety goggles. If handling in poorly ventilated areas, SCBA or fullface supplied air respirator should be worn.

670-4.8.3.3.1 In case of skin contact with hydraulic fluids containing tricresyl phosphates, wash with soap and water for 15 minutes. Get medical assistance for personnel who have contacted or inhaled tricresyl phosphates. If a spill occurs, wipe up with rags and wash the area with detergent while providing local forced ventilation. Standard safety procedures for handling flammable items should be followed.

670-4.8.4 CAULKING COMPOUNDS. Caulking compounds (polymer, polysulfide, and accelerator), antiseize compound, putty, battery sealing compound, white lead (alkaline carbonate paste in oil), and leak test compound Types I and II are toxic and combustible. Flashpoints may vary, and certain compounds should be handled as Category I flammables.

670-4.8.4.1 Vapors produced are heavier than air and adequate ventilation shall be provided to prevent accumulation. Consult the Gas Free Engineer. Neoprene gloves and safety glasses should be worn while handling these materials. Prolonged inhalation of vapors should be avoided. Wash hands thoroughly after use.

## **SECTION 5.**

### **OXIDIZING MATERIALS**

#### **670-5.1 DEFINITION**

670-5.1.1 An oxidizing material is a material that reacts violently enough to produce heat, or stimulates combustion by producing oxygen when in contact with organic materials. These reactions occur at normal temperatures or under slight heating. Higher temperatures increase the possibility of oxygen release and initiation of fire. Heat shall be avoided when handling and stowing oxidizers. Chlorates, perchlorates, peroxides, nitrates, and permanganates are classified as oxidizers. Calcium hypochlorite is a particularly reactive oxidizer found aboard ship, and special precautions are addressed in paragraph [670-5.5](#).

#### **670-5.2 STOWAGE**

670-5.2.1 Do not stow oxidizers near heat sources, in areas adjacent to magazines, or in areas where the maximum temperature exceeds 37.8°C (100°F) under normal operating conditions.

670-5.2.2 Keep oxidizers isolated from fuels, oils, greases, paints, organic solvents, cellulose products, and any other material that is easily oxidized. These materials are incompatible and may cause violent reaction and fire. Stowage areas shall be kept cool, dry, and well-ventilated. Inspect stowage areas regularly for container integrity and to ensure compliance with the foregoing restrictions.

670-5.2.3 Containers used for holding oxidizers shall have a warning label indicating their reactivity and associated hazards.

#### **670-5.3 HANDLING**

670-5.3.1 Do not use oxidizers where they might mix with easily oxidized materials (see paragraph [670-5.2.2](#)). Do not handle oxidizers near open flames or heated surfaces.

670-5.3.2 Handle only in well ventilated areas. Concentrated vapors may be toxic and irritating to eyes, lungs, or skin. Permanganates are highly toxic and have chronic effects on the central nervous system. Perchloric acid is highly toxic when inhaled and is an extreme irritant.

670-5.3.3 Personnel handling oxidizers are required to wear neoprene gloves, safety splash goggles, and protective coveralls. For oxidizers that are also caustic, face shields shall also be worn. Only authorized personnel may handle oxidizers.

670-5.3.4 Spill response depends on the material involved.

- a. Calcium hypochlorite. See paragraph [670-5.5](#) through [670-5.5.4](#).
- b. Sodium nitrate. For small spills, dilute with water and wash down drain. For large spills, dilute to acceptable discharge level and pH, and wash down drain.
- c. Hydrogen peroxide. For small spill, dilute with water and wash down drain. For large spills, restrict access and flush with water. Wear protective clothing and oxygen breathing apparatus.
- d. Ammonium perchlorate. Should be handled only by ordnance experts.

670-5.3.5 Oxidizing materials should never be transferred to a different container unless that container has been purged and has the appropriate warning label affixed. The container shall be compatible with the oxidizing material.

670-5.3.6 Never remove warning labels from a container that has contained oxidizing materials unless it has been purged according to NSTM Chapter 593, Pollution Control .

## **670-5.4 DISPOSAL**

670-5.4.1 Each oxidizing material shall be containerized for shore disposal in separate, compatible containers. Extreme care shall be taken to prevent contact with organic and flammable materials. Each container shall be clearly labeled.

## **670-5.5 CALCIUM HYPOCHLORITE**

670-5.5.1 GENERAL. Calcium hypochlorite is a very strong oxidizer and can be extremely hazardous if not handled properly. It is authorized for shipboard use for emergency purification of potable water, sewage waste treatment, and Biological and Chemical (B/C) agent decontamination. Stocks of calcium hypochlorite shall be maintained specifically for B/C decontamination. Only 6-ounce bottles shall be procured and used for emergency water purification and B/C decontamination. For sewage waste treatment, 3.75-pound bottles shall be used.

670-5.5.2 HAZARDS. The stowage hazards of oxidizing materials outlined in paragraph [670-5.2](#) apply. These hazards are extreme. Calcium hypochlorite will react with rags, fabrics, detergent, antifreeze, and ammonia in addition to the materials listed previously. When heated, calcium hypochlorite decomposes to chlorine gas, phosphene, and other toxic and corrosive fumes.

670-5.5.2.1 Contact with moisture causes formation of toxic chlorine gas. Accidental mixture with small amounts of water spray from firefighting may cause toxic gas formation. This reaction can be controlled by drenching with excess water. Mixing of calcium hypochlorite solutions for decontamination requires extreme care, thorough training, and close supervision. This will ensure that sufficient water is used in proportion to calcium hypochlorite.

670-5.5.3 STOWAGE. Calcium hypochlorite shall not be stowed in machinery spaces, storerooms, flammable liquid stowage areas, berthing spaces, or oil and water test laboratory areas. Stowage shall not be in areas used for stowage of greases, oils, paints, or other combustible materials. Stowage shall be away from oil lines and other potential sources of combustible material, and at least 5 feet from any source or surface which may exceed 60°C (140°F). Stowage areas shall not be subject to condensation or water accumulation. The stowage requirement of paragraph [670-5.2](#) shall be observed.

670-5.5.3.1 Ready-use stock issued to Medical and Engineering Departments shall be stowed in a locked box mounted on a bulkhead, preferably in the cognizant department office space. A metal box, such as a first aid locker, is recommended. Vent holes (such as three 1/4-inch holes) shall be drilled in the bottom of the box to allow release of any chlorine products. The box is to be painted according to paragraph 670-5.5.3.7.

670-5.5.3.2 The stock of 6-ounce bottles of calcium hypochlorite issued for decontamination purposes shall be stowed in locked boxes according to requirements in paragraph 670-5.5.3.1. See NSTM Chapter 470, Shipboard BW/CW Defense and Countermeasures , for specified allowances. Stowage for personnel decontamination use shall be in bulkhead mounted lockers located near to each decontamination station or contamination control area. Additional stowage for deck and equipment spot decontamination use shall be provided in controlled areas such as engineering office or supply storerooms.

670-5.5.3.3 For submarines, ready-use stocks issued to Medical and Engineering Department shall be stowed in a Medical Instrument and Supply Set Case, NSN 6546-00-131-6992. This case shall be kept in a secured locker painted according to paragraph 670-5.5.3.7.

670-5.5.3.4 Ready-use stocks for sewage treatment shall be stowed in steel cabinets or racks located on a bulkhead in the macerator chlorinator space. The cabinets or racks shall have shelving or retaining bars to hold individual containers securely. No paint, oils, greases, or other combustible organic material shall be stowed in this space.

670-5.5.3.5 Storeroom stocks for water purification and B/C decontamination shall be stowed in labeled, ventilated lockers or bins. The lockers or bins shall be located in an area that meets the requirements of paragraph 670-5.5.3. No more than forty-eight 6-ounce bottles or thirty-six 3.75-pound bottles shall be stowed in any individual locker or bin. Issue shall be made only to personnel designated by the Medical Officer or Engineering Officer.

670-5.5.3.6 Calcium hypochlorite carried as cargo shall be stowed in a separate enclosure constructed of steel. The enclosure shall be located in an area meeting the requirements of paragraph 670-5.5.3. Sprinkler protection is not required but can be used. For material not on pallets, the enclosure shall have shelving and retaining bins to securely hold the individual containers or boxes.

670-5.5.3.7 All lockers, bins, and enclosures used to stow calcium hypochlorite shall be painted gray and labeled with red letters on a white background: HAZARDOUS MATERIAL, CALCIUM HYPOCHLORITE .

670-5.5.4 HANDLING. Calcium hypochlorite shall not be used near paints, oils, greases, detergents, or other organic materials described in paragraph 670-5.5.2. Do not use near heat sources or open flames because toxic gases may be produced. Only personnel with proper training are authorized to handle calcium hypochlorite.

## **670-5.6 ORGANIC CHLORINE LAUNDRY BLEACH (SPECIFICATION O-B-420)**

670-5.6.1 This bleach is authorized for use only on surface ships. It is less hazardous than calcium hypochlorite, but under conditions of high heat and humidity, it may release toxic chlorine fumes. Stowage and handling should be in cool, dry areas away from sources of heat and moisture. Use general precautions for oxidizers.

## SECTION 6.

### CORROSIVE MATERIALS

#### 670-6.1 DEFINITION

670-6.1.1 A corrosive material is a solid, liquid, or gas that chemically attacks or degrades other substances. Corrosives include acids, alkalies, some metals (such as mercury), and some gases. The hazard of an acid or alkali increases as its concentration increases.

#### 670-6.2 HAZARDS

670-6.2.1 Corrosive materials can damage, burn, or irritate living tissue, attack structural metals, and ignite or produce violent reactions when in contact with certain chemicals or materials. The addition of water to strong acids or bases may generate large amounts of heat and cause container breakage. Some corrosive materials generate flammable or explosive vapors, and most give off vapors which are irritating to eyes and lungs.

#### 670-6.3 STOWAGE

670-6.3.1 Corrosive materials shall be stowed in designated stowage chests that are lined with lead or other corrosion-resistant material, and have corrosion-resistant flanges. Acids and alkalies (bases) shall be stowed separated from each other. Organic acids shall be separated from inorganic acids.

670-6.3.2 Stow corrosives in cool, dry, well ventilated areas away from heat sources and hot work areas. Bulk stowage of alkalies shall be in dry storage or in designated lockers, well separated from acids. Bulk stowage of acids, except those for medical purposes, shall be in designated lockers or chests in the flammable liquids storeroom, (or in the acid storeroom, if available). Stowage of in-use corrosives in work spaces is restricted. Weatherdeck stowage in watertight lockers is permitted if containers are protected from freezing.

670-6.3.3 Corrosives shall be stowed in original containers. If the original container leaks, personnel shall be absolutely certain that the replacement container is compatible with the corrosive material (see [Table 670-1-3](#)).

#### 670-6.4 HANDLING

670-6.4.1 GENERAL. Strict precautions shall be taken when handling corrosives. Avoid contact with skin and clothing. Avoid breathing fumes or vapors.

670-6.4.1.1 Personnel Protective Clothing and Equipment (PPE) required when handling corrosives includes neoprene or butyl rubber gloves, gas-tight chemical goggles, chemically-resistant rubber boots or overshoes, and coveralls or rubber apron. If exhaust ventilation is not available, an appropriate respirator shall be worn. Chemical cartridge respirators exist for acids, organic vapors, ammonia and combinations of these. Supplied air respirators should be used for extreme spills or emergencies. Face shields worn over gas-tight goggles provide additional protection.

670-6.4.1.2 Handling areas shall be kept cool, dry, and well ventilated because some acids generate explosive gases. Open flames and spark-producing equipment are not permitted in these areas.

670-6.4.1.3 Keep corrosives away from incompatible materials because of the danger of violent reaction. Do not transfer corrosives to containers that might be made of an incompatible material. See paragraph [670-6.3](#) for specific guidance.

670-6.4.1.4 When diluting acids or alkalies, considerable heat may be produced. Add the acid or alkali slowly and carefully to the water (preferably cool water), stirring constantly. Never add water to the chemical .

670-6.4.2 SPILLS. In the event of a spill, first neutralize the corrosive material, if possible. Neutralize acids with slaked lime (calcium hydroxide) or bicarbonate. Neutralize alkalies with weak acetic acid (vinegar) or dilute (weak) sulfamic acid. Never use strong alkalies to neutralize acids, or strong acids to neutralize alkalies. Test for pH to determine if the spill is adequately neutralized. Collect the residue, using absorbents if necessary, and rinse the affected area with water.

670-6.4.3 FIRST AID. If a corrosive material contacts the eyes, flush with water for 15 minutes and get immediate medical attention. In case of skin contact, flush the affected skin area with water, then wash with soap and water. If corrosive vapors are inhaled, move the victim to fresh air and get immediate medical attention.

## **670-6.5 CLASSES**

670-6.5.1 ALKALIES. Alkalies (bases) include sodium hydroxide, potassium hydroxide, sodium di- and triphosphates, sodium carbonate, lye, slaked lime (calcium hydroxide), and ammonia. Some batteries may contain alkalies. Alkalies may be liquid or solid.

670-6.5.1.1 Stow according to paragraph [670-6.3](#). Keep separated from acids, oxidizers, and other incompatible materials.

670-6.5.1.2 Handle according to paragraph [670-6.4](#). Do not allow contact with acids, oxidizers, or other incompatible materials. In case of a spill, neutralize with weak acetic acid. If acetic acid is unavailable, use dilute sulfamic acid. Solid alkalies may be collected without neutralizing if PPE is used. Consult the Hazardous Material/Hazardous Waste Coordinator for disposal.

670-6.5.2 ACIDS. This class includes inorganic acids such as hydrochloric, hydrofluoric, sulfuric, sulfamic, nitric, and phosphoric; and organic acids such as acetic, oxalic, carbolic, cresylic, and picric acids.

670-6.5.2.1 General. Use general stowage and handling requirements of paragraphs [670-6.3](#) and [670-6.4](#). Do not allow contact with alkalies, oxidizers, or other incompatible materials. Do not stow or use acids near flames or other ignition sources because acids may give off explosive gases. Do not stow inorganic and organic acids together. In acid storerooms, keep inorganic and organic acids as far apart as possible.

670-6.5.2.2 Spills. Remove all ignition sources. Neutralize with slaked lime (calcium hydroxide) or bicarbonate. Wipe up the residue immediately, and flush the spill area with large amounts of water. Avoid accumulation of acid mist or vapor.

670-6.5.2.3 Inorganic Acids. These acids are generally nonflammable, but may be oxidizing agents (perchloric, nitric, sulfuric acids) or may react with metals or other materials to give off flammable or toxic vapors such as hydrogen gas (hydrofluoric, hydrochloric, phosphoric, nitric acids). Hydrofluoric acid is particularly harmful.

670-6.5.2.3.1 If hydrofluoric acid contacts the eyes, flush with water for 15 minutes and get immediate medical attention. In case of skin contact, flush the affected skin area with water. To avoid further damage to already burned skin, do not use high-pressure streams of water. Place the exposed area in a cool solution of 25 percent magnesium sulfate (vials of 50 percent magnesium sulfate, diluted 1:1 with water). If the area is larger or on the upper body trunk, cool compresses saturated with the 25-percent magnesium sulfate solution should be used. All burns caused by hydrofluoric acid should be seen by a physician. Most cases require further treatment with injections of calcium gluconate.

670-6.5.2.4 Organic Acids. These acids may react with oxidizers (including some inorganic acids), and some (such as acetic, oxalic, and formic acids) are flammable.

## **670-6.6 DISPOSAL**

670-6.6.1 If neutralization of spent acids or alkalies is not possible, containerize for shore disposal and keep separate from all other materials. Consult NSTM Chapter 593, Pollution Control , for detailed instructions.

670-6.6.2 Spent alkalies can be neutralized by slowly adding a weak acid such as dilute acetic acid (vinegar) to the alkali. Spent acids can be neutralized by slowly adding sodium bicarbonate or a weak alkaline solution (such as dilute calcium hydroxide) to the acid. The pH of the solution shall be between 6.0 and 8.0 before it can be diluted and discharged overboard. Test the pH with litmus paper (NSN 6640-00-096-8195 or 6640-00-592-8170). If the solution is acidic, the paper will turn red; if the solution is alkaline, the paper will turn blue. A neutral solution will not change the color of the litmus paper. When the pH of the neutralized solution is between 6.0 and 8.0, add the solution to large amounts of seawater and discharge overboard. Detailed neutralization procedures are contained in NSTM Chapter 593 .



## APPENDIX A.

## CHEMICAL SUBSTANCE COMPATIBILITY DATA

## 670-A.1

Table 670-A-1 is a complete listing of chemical substances. The first column lists the material by chemical or trade name. Trade names are identified by asterisks (\*). If a synonym or common name for the substance is available, it is given in the second column. The third column identifies the Reactivity Group Number (RGN) of the substance. A compound may be assigned more than one RGN.

## 670-A.2

Figure 670-A-1 is a hazardous materials compatibility chart. It is used in conjunction with Table 670-A-1 to determine compatibility of any combination of chemical substances.

## 670-A.3

The following procedure, with examples, demonstrates the usage of Table 670-A-1 and Figure 670-A-1:

- Using Table 670-A-1, determine the RGN's of any two chemical substances. For example: butyl acetate, also known as acetoxybutane, has an RGN of 13, and calcium hypochlorite, also known as calcium oxychloride, has an RGN of 104.
- Using Figure 670-A-1, find RGN's 13 and 104 in the left hand column. The reactivity group names are esters and oxidizing agents, strong, respectively.
- Using the RGN 104 line (the highest of the two numbers), proceed to the right until the intersection with the vertical column for RGN 13 is reached. Note the reactivity codes, if any, at that intersection. In this case, the codes H, for heat generation, and F, for fire, are given.

## 670-A.4

This example shows that butyl acetate and calcium hypochlorite are not compatible, and if brought together, may produce heat or fire.

Table 670-A-1. CHEMICAL SUBSTANCES

Names	Synonyms	RGN
Abate*		32
Acenaphthene		16
Acetamide		6
Acetaldehyde		5
Acetic acid		3
Acetic anhydride		107
Acetone	Dimethyl ketone	19
Acetone cyanohydrin	Hydroxyisobutyronitrile	4, 26
Acetronitrile	Methyl cyanide	26
Acetophenone		19
Acetoxybutane	Butyl acetate	13
Acetoxypentane	Amyl acetate	13

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Acetyl acetone		19
Acetyl azide		102
Acetyl benzoyl peroxide		30
Acetyl bromide		17, 107
Acetyl chloride		17, 107
Acetylene		28
Acetyl nitrate		27, 102
Acetyl peroxide		30
Acrolein	Aqualin	5, 103
Acrylic acid		3, 103
Acrylonitrile		26, 103
Adipic acid		3
Adiponitrile		26
Agallol	Methoxyethylmercuric chloride	24
Agaloaretan	Methoxymethylmercuric chloride	24
Adlicarb	Temik*	9, 20
Aldrin		17
Alkyl aluminum chloride		107
Alkyl resins		101
Allene		28
Allyl alcohol	2-Propen-1-ol	4
Allyl bromide	Bromopropene	17
Allyl chloride	Chloropropene	17
Allyl chlorocarbonate	Allyl Chloroformate	13, 17
Allyl chloroformate	Allyl chlorocarbonate	13, 17
Allyl trichlorosilane		107
Aluminum		22, 23
Aluminum aminoborohydride		107
Aluminum borohydride		105, 107
Aluminum bromide		107
Aluminum carbide		105
Aluminum chloride		107
Aluminum dethyl monochloride	Diethylaluminum chloride	105, 107
Aluminum fluoride		15, 107
Aluminum hydride		105
Aluminum hypophosphide		107
Aluminum phosphide		107
Aluminum tetraazidoborate		8
Aminobenzene	Aniline	7
Aminobutane	Butylamine	7
Aminochlorotoluene	Chlorotoluidine	7, 17
Aminodiphenyl		7
Aminoethane	Ethylamine	7
Aminoethanol		4, 7
Aminoethanolamine		7
Aminohexane	Hexylamine	7
Aminomethane	Methylamine	7

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Aminopentane	Amylamine	7
Aminophenol		7, 31
Aminopropane	Isopropyl amine	7
Amino propionitrile		7, 26
Aminothiazle		7, 8
Aminotoluene	Toluidine	7
Ammonia		10
Ammonium arsenate		24
Ammonium azide		102
Ammonium bifluoride		15
Ammonium chlorate		102, 104
Ammonium dichromate		24, 102
Ammonium fluoride		15
Ammonium hexanitrocobaltate		24, 102
Ammonium hydroxide		10
Ammonium hypophosphide		105
Ammonium molybdate		24
Ammonium nitrate		102
Ammonium nitrodoosmate		24, 104
Ammonium nitrite		102
Ammonium perchlorate		104
Ammonium periodate		102, 104
Ammonium permanganate		24, 102, 104
Ammonium persulfate		104
Ammonium picrate		102
Ammonium sulfide		33, 105
Ammonium tetrachromate		24, 104
Ammonium tetraperoxychromate		24, 102, 104
Ammonium trichromate		24, 104
Amyl acetate	Acetoxy pentane	13
Amyl alcohol		4
Amyl chloride	Chloropentane	17
Amyl cyanide		26
Amylamine	Aminopentane	7
Amylene	Pentene	28
Amyl mercaptan	Pentanethiol	20
Aniline		7
Animert* V-101	Tetrasul	20
Anisole		14
Anisole chloride		107
Anthracene		16
Antimony		23, 24
Antimony chloride	Antimony trichloride	24, 107
Antimony fluoride	Antimony trifluoride	24, 107
Antimony nitride		24, 25
Antimony oxychloride		24
Antimony oxide	Antimony trioxide	24

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Antimony pentachloride		24
Antimony pentafluoride		24
Antimony pentasulfide		24, 33, 105
Antimony perchlorate		24, 104
Antimony potassium tetratrate		24
Antimony sulfate	Antimony trisulfate	24
Antimony sulfide	Antimony trisulfide	24, 33, 105
Antimony tribromide		24, 107
Antimony trichloride	Antimony chloride	24, 107
Antimony trifluoride	Antimony fluoride	24, 107
Antimony triiodide		24, 107
Antimony trioxide	Antimony oxide	24
Antimony trisulfate	Antimony sulfate	24
Antimony trisulfide	Antimony sulfide	24, 33
Antimony trivinyl		24, 107
Aqualin	Acrolein	5, 103
Aqueous solutions & mixtures		106
Aretan*	Methoxyethylmercuric chloride	24
Aroclor*	Polychlorinated biphenyl	17
Arsenic		24
Arsenic bromide	Arsenic tribromide	24, 107
Arsenic chloride	Arsenic trichloride	24, 107
Arsenic disulfide	Arsenic sulfide	24, 33, 105
Arsenic iodide	Arsenic triiodide	24, 107
Arsenic oxide	Arsenic pentoxide	24
Arsenic pentaselenide		24
Arsenic pentasulfide		24, 33
Arsenic pentoxide	Arsenic oxide	24
Arsenic sulfide	Arsenic disulfide	24, 33, 105
Arsenic tribromide	Arsenic bromide	24, 107
Arsenic trichloride	Arsenic chloride	24, 107
Arsenic trifluoride		24
Arsenic triiodide	Arsenic iodide	24, 107
Arsenic trisulfide		24, 33, 105
Arsine		24, 105
Askarel	Polychlorinated biphenyl	17
Asphalt		101
Azidocarbonyl guanidine		8, 102
Azido-s-triazole		8
Azinphos ethyl		32
Aziridine	Ethyleneimine	7, 103
a,a'-Azodiisobutyronitrile		8, 26
Azodrin*	Monocrotophos	32
Bakelite*		101
Banol	Carbanolate	9
Barium		21, 24, 107
Barium azide		24, 102

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Barium bromate		24, 104
Barium carbide		24, 105, 107
Barium chlorate		24, 104
Barium chloride		24
Barium chromate		24, 104
Barium fluoride		15, 24
Barium fluosilicate		24
Barium hydride		24, 105
Barium hydroxide		10, 24
Barium hypophosphide		24, 105
Barium iodate		24, 104
Barium iodide		24
Barium monoxide	Barium oxide	10, 24, 107
Barium nitrate		24, 104
Barium oxide	Barium monoxide	10, 24, 107
Barium perchlorate		24, 104
Barium permanganate		24, 104
Barium peroxide		24, 104
Barium phosphate		24
Barium stearate		24
Barium sulfide		24, 33, 105, 107
Barium sulfite		24
Bassa*	BPMC	9
Bayer 25141	Fensulfothion	32
Baygon*		9
Benzadox	Topcide*	6
Benzal bromide		17
Benzal chloride		17
Benzaldehyde		5
Benz-a-pyrene		16
Benzene		16
Benzene diazonium chloride		8, 102
Benzene phosphorus dischloride		107
Benzidine		7
Benzoic acid		3
Benzonitrile		26
Benzophenone		19
Benzoquinone	Quinone	19
Benzotriazole		8, 102
Benzotribromide		17
Benzotrichloride		17
Benzotrifluoride	Trifluoromethylbenzene	17
Benzoyl chloride		107
Benzoyl peroxide	Dibenzoyl peroxide	30, 102
Benzyl alcohol		4
Benzylamine		7
Benzyl benzene	Diphenylmethane	16

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Benzyl bromide	Bromotoluene	17
Benzyl chloride	Chlorotoluene	17
Benzyl chlorocarbonate	Benzyl chloroformate	17
Benzyl chloroformate	Benzyl chlorocarbonate	17
Benzyl silane		105, 107
Benzyl sodium		105
Beryllium		24
Beryllium copper alloy		24
Beryllium fluoride		15, 24
Beryllium hydride		24, 105, 107
Beryllium hydroxide		10, 24
Beryllium oxide		24
Beryllium sulfide		33, 105
Beryllium tetrahydroborate		24, 105, 107
Bidrin*		32
Bismuth		22, 23, 24
Bismuth chromate		24
Bismuthic acid		24
Bismuth nitride		24, 25, 102
Bismuth pentafluoride		24, 107
Bismuth pentaoxide		24
Bismuth sulfide		24, 33, 105
Bismuth tribromide		24
Bismuth trichloride		24
Bismuth triiodide		24
Bismuth trioxide		24
Bismuth trisulfide		24, 33, 105
Blada-fum*	Sulfotepp	32
Blue vitriol	Copper sulfate	24
Bomyl		32
Borane		24, 107
Bordeaux arsenites		24
Boric acid		1
Boron arsenotribromide		24, 105
Boron bromodiiodide		24, 107
Boron dibromoiiodide		24, 107
Boron nitride		24, 25
Boron phosphide		24, 107
Boron triazide		24, 102
Boron tribromide		24, 107
Boron trichloride		24, 107
Boron trifluoride		24, 107
Boron triiodide		24, 107
Boron trisulfide		24, 33, 105
BPMC	Bassa*	9
Brass		23
Bromic acid		2

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Bromine		104
Bromine azide		102
Bromine cyanide	Cyanogen bromide	11
Bromine monofluoride		104, 107
Bromine pentafluoride		104, 107
Bromine trifluoride		104, 107
Bromoacetylene		17
Bromobenzoyl acetanilide		6, 19
Bromobenzyl trifluoride		17
Bromodiborane		105
Bromodiethylaluminum		107
Bromodimethoxyaniline		14
Bromoform	Tribromomethane	17
Bromomethane	Methyl bromide	17
Bromophenol		17, 31
Bromopropene	Allyl bromide	17
Bomopropyne		17
Bromosilane		105
Bromotoluene	Benzyl bromide	17
Bromotrichloromethane		17
Bromotrifluomethane		17
Brmoxynil	3,5-Dibromo-4-hydroxy benzonitrile	17, 26, 31
Bronze		23
Buna<#0106>N*		101
Bunker fuel oil		101
Butacarb		9
Butadiene		28, 103
Butadiyne	Diacetylene	28
Butanal	Butyraldehyde	5
Butane		29
Butanediol		4
Butanethiol	Butyl mercaptan	20
Butanetriol trinitrate		102
Butanol	Butyl alcohol	4
Butanone	Methyl ethyl ketone	19
Butenal	Crotonaldehyde	5
Butene		28
Butene-2-one	Methyl vinyl ketone	19
Butyl acetate	Acetoxybutane	13
n<#0106>Butyl acrylate		13, 103
Butylamine	Aminobutane	7
Butyl alcohol	Butanol	4
t-Butyl azidoformate		8
Butyl benzene	Phenylbutane	16
Butyl benzyl phthalate		13
Butyl cellusolve*		4
Butyl dichloroborane		105

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Butyl ether	Dibutyl ether	14
Butyl formate		13
Butyl fluoride		17
Butyl glycidyl ether		34
Butyl hydroperoxide		30
t-Butyl hypochlorite		102, 104
n-Butyl lithium		105, 107
Butyl mercaptan	Butanethiol	20
Butyl peroxide		30
Butyl peroxyacetate	t-Butyl perbenzoate	30
Butyl peroxybenzoate		30
Butyl peroxy-pivalate		30
t-Butyl perbenzoate	Butyl peroxyacetate	30
-Butyl-3-phenyl oxazirane		34
Butyl trichlorosilane		107
Butyramide		6
Butyraldehyde	Butanol	5
Butyric acid		3
Butyronitrile		26
Bux*		9
Cacodylic acid	Dimethylarsenic acid	24
Cadmium		23, 24
Cadmium acetylide		24, 105, 107
Cadmium amide		24, 10, 107
Cadmium azide		24, 102
Cadmium bromide		24
Cadmium chlorate		24, 104
Cadmium chloride		24
Cadmium cyanide		11, 24
Cadmium fluoride		15, 24
Cadmium hexamine chlorate		24, 102
Cadmium hexamine perchlorate		24, 102
Cadmium iodide		24
Cadmium nitrate		24, 102, 104
Cadmium nitride		24, 25, 102
Cadmium oxide		24
Cadmium phosphate		24
Cadmium sulfide		24, 33, 105
Cadmium trihydrazine chlorate		24, 102
Cadmium trihydrazine perchlorate		24, 102
Calcium		24, 102
Calcium arsenate		24
Calcium arsenite		24
Calcium bromate		104
Calcium carbide		105, 107
Calcium chlorate		104
Calcium chlorite		104

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Calcium fluoride		15
Calcium hexammoniate		105
Calcium hydride		105, 107
Calcium hydroxide	Hydrated lime	10
Calcium hypochlorite	Calcium oxychloride	104
Calcium hypophosphide		105
Calcium iodate		104
Calcium-manganese-silicon alloy		23
Calcium nitrate	Lime nitrate, nitrocalcite	104
Calcium oxide	Slaked lime	10, 107
Calcium oxychloride	Calcium hypochlorite	104
Calcium perchromate		104
Calcium permanganate		104
Calcium peroxide		104
Calcium phosphide		107
Calcium sulfide		33, 105
Camphor oil		101
Capric acid		3
Caproic acid	Hexanoic acid	3
Caprylic acid		3
Caprylyl peroxide	Octyl peroxide	30
Carbacrol		31
Carbaryl		9
Carbetamide		6
Carbanolate	Banol	9
Carbofuran	Furadan*	9
Carbolic acid	Phenol	31
Carbolic oil		31
Carbon, activated, spent		101
Carbon bisulfide	Carbon disulfide	20
Carbon disulfide	Carbon bisulfide	20
Carbon tetrachloride	Tetrachloromethane	17
Carbon tetrafluoride		17
Carbon tetraiodide		17
Castrix	Crimidine	7
Catechol		31
Caustic potash	Potassium hydroxide	10
Caustic soda	Sodium hydroxide	10
CDEC		12
Cellulose		101
Cellulose nitrate	Nitro cellulose	27, 102
Cerium		22
Cerium hydride		105
Cerium trisulfide		33, 105
Cerous phosphide		105
Cesium		21
Cesium amide		107

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Cesium azide		102
Cesium carbide		105
Cesium fluoride		15
Cesium hexahydroaluminate		105
Cesium hydride		105, 107
Cesium phosphide		107
Cesium sulfide		33, 105
Chloral hydrate	Trichloroacetaldehyde	5
Chlordane		17
Chlorestol	Polychlorinated biphenyl	17
Chlorfenvinphos		32
Chloric acid		2, 104
Chlorine		104
Chlorine azide		102
Chlorine dioxide		102, 104, 107
Chlorine fluoroxide		102, 104
Chlorine monofluoride		104, 107
Chlorine monoxide		104
Chlorine pentafluoride		104, 107
Chlorine trifluoride		104, 107
Chlorine trioxide		102, 104
Chloroacetaldehyde		5, 17
Chloroacetic acid	Monochloroacetic acid	3, 17
Chloroacetone	Monochloroacetone	17, 19
Chloroacetophenone	Phenyl chloromethyl ketone	17, 19
Chloroacetyl chloride		107
Chloroacetylene		102
Chloroacrylonitrile		17, 26
Chloroazodin		8, 17
Chlorobenzene		17
Chlorobenzotriazole		8, 17
Chlorobenzoyl peroxide		17, 30
Chlorobenzylidene malononitrile		17, 26
Chlorobutyronitrile		17, 26
Chloro chromic anhydride	Chromyl chloride	24, 104, 107
Chlorocresol		17, 31
Chlorodiborane		105
Chlorodiisobutyl aluminum		105, 107
Chlorodimethylamine diborane		105
Chlorodinitrobenzene	Dinitrochlorobenzene	17, 27
Chloro dinitrotoluene		17, 27
Chlorodipropyl borane		105
Chloroethane	Ethyl chloride	17
Chloroethanol		4, 7
Chloroethylenimine		17
Chloroform	Trichloromethane	17
Chlorohydrin		17

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Chloromethane	Methyl chloride	17
Chloromethyl methyl ether		17
Chloromethyl phenoxyacetic acid		3, 17
Chloronitroaniline		17, 27
Chloronitrobenzene	Nitrochlorobenzene	17, 27
Chloropentane	Amyl chloride	17
Chlorophenol		31
Chlorophenyl isocyanate		17, 18, 107
Chloropincrin	Chlorpicrin, Trichloronitromethane	17, 27, 102
Chloropropane	Isopropyl chloride	17
Chloropropene	Allyl chloride	17
Chloropropylene oxide	Epichlorohydrin	17, 34
Chlorosilane		105
Chlorosulfonic acid		1
Chlorothion*		17, 32
Chlorotoluene	Benzyl chloride	17
Chlorotoluidine		7, 17
Chlorotrinitrobenzene	Picryl chloride	17, 27, 102
B-Chloroinyldichloroarsine	Lewisite	24
Chlorpicrin	Trichloronitromethane	17, 27, 102
Chromic acid	Chromic anhydride, Chromium trioxide	2, 24, 104
Chromic anhydride	Chromium trioxide, Chromic acid	2, 24, 104
Chromic chloride	Chromium trichloride	24
Chromic fluoride	Chromium trifluoride	15, 24
Chromic oxide		24
Chromic sulfate	Chromium sulfate	24
Chromic sulfide		24, 33, 105
Chromium		23, 24
Chromium sulfate	Chromic sulfate	24
Chromium trichloride	Chromic chloride	24
Chromium trifluoride	Chromic fluoride	15, 24
Chromium trioxide	Chromic acid, Chromic anhydride	2, 24, 104
Chromyl chloride	Chloro chromic anhydride	24, 104, 107
Chrysene		16
CMME	Methyl chloromethyl ether	14, 17
Coal oil		101
Coal tar		31
Cobalt		22, 23, 24
Cobalt bromide	Cobaltous bromide	24
Cobalt chloride	Cobaltous chloride	24
Cobalt nitrate	Cobaltous nitrate	24, 104
Cobaltous bromide	Cobalt bromide	24
Cobaltous chloride	Cobalt chloride	24
Cobaltous nitrate	Cobalt nitrate	24, 104
Cobaltous resinate	Cobalt resinate	24
Cobaltous sulfate	Cobalt sulfate	24
Cobalt resinate	Cobaltous resinate	24

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Cobalt sulfate	Cobaltous sulfate	24
Collodion	Pyroxylin	27
Copper		23, 24
Copper acetoarsenite	Paris Green	24
Copper acetylde		24, 102, 105, 107
Copper arsenate	Cupric arsenate	24
Copper arsenite	Cupric aresenite	24
Copper chloride	Cupric chloride	24
Copper chlorotetrazole		24
Copper cyanide	Cupric cyanide	11, 24
Copper nitrate	Cupric nitrate	24, 104
Copper nitride		24, 25
Copper sulfate	Cupric sulfate, Blue vitriol	24
Copper sulfide		24, 33, 105
Compound 1836	Diethyl chlorvinyl phosphate	17, 32
Coroxon*		32
Coumafuryl	Fumarin	19
Coumatetralyl		19
Cresol		31
Cresol glycyll ether		34
Cresote		31
Crimidine	Castrix	7
Crotonaldehyde	Butenal	5
Crotyl alcohol		4
Crotyl bromide		17
Crotyl chloride		17
Cumene	Isopropyl benzene	16
Cumene hydroperoxide	Dimethylbenzyl hydroperoxide	30
Cupric arsenate	Copper arsenate	24
Cupric arsenite	Copper arsenite	24
Cupric chloride	Copper chloride	24
Cupric cyanide	Copper cyanide	11, 24
Cupric nitrate	Copper nitrate	24, 104
Cupric sulfate	Copper sulfate	24
Cupriethylenediamine		7, 24
Cyanoacetic acid	Malonic nitrile	3, 26
Cyanochloropentane		17, 26
Cyanogen		26
Cyanogen bromide	Bromine cyanide	11
Cyanophenphos	Surecide*	26, 32
Cyanuric triazide		102
Cycloheptane		29
Cyclohexane		29
Cyclohexanol		4
Cyclohexanone		19
Cyclohexanone peroxide		30
Cyclohexylamine		7

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Cyclohexenyl trichlorosilane		107
Cyclohexyl phenol		31
Cyclohexyl trichlorosilane		107
Cyclopentane		29
Cyclopentanol		4
Cyclopentene		28
Cyclopropane		29
Cyclotrimethylene trinitraamine	RDX	27, 102
Cymene		16
Cyolan*	Phospholan	20, 32
2, 4-D	Dichlorophenoxyacetic acid	3, 17
Dasanit*	Fensulfothion	32
DBCP	Dibromochloropropane	17
DCB	Dichlorobenzene	17
DDD		17
DDNP	Diazodinitrophenol	8, 27, 102
DDT		17
DDVP	Dichlorovos, Vapona*	17, 32
DEAC	Diethylaluminum chloride	105, 107
Decaborane		107
Decahydronaphthalene	Decalin	29
Decalin	Decahydronaphthalene	29
Decane		29
Decanol		4
Decene		28
Decyl benzene		16
Delnav*	Dioxathion	32
Demeton-s-methyl sulfoxid	Metasystox R*	32
Diacetone alcohol		4, 19
Diacetyl		19
Diacetylene	Butadiyne	28
Diamine	Hydrazine	8, 105
Diaminobenzene	Phenylene diamine	7
Diaminohexane	Hexamethylenediamine	7
Diazidoethane		8, 102
Diazinon*		32
Diazodinitrophenol	DDNP	27, 102
Dibenzoyl peroxide	Benzoyl peroxide	30, 102
Diborane	Diboron hexahydride	105, 107
Diboron hexahydride	Diborane	105, 107
Dibutyl ether	Butyl ether	14
Dibutyl phthalate		13
3, 5-Dibromo-4-hydroxybenzonitrile	Bromoxynil	17, 26, 31
Dibromochloropropane	DBCP, Fumazone*, Nemagon*	17
Dibromoethane	Ethylene dibromide	17
Dichloroacetone		17, 19
Dichloroamine		104

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Dichlorobenzene	DCB	17
Dichlorobenzidine		7, 17
Dichlorodimethylsilane	Dimethyl dichlorosilane	107
Dichloroethane	Ethylene dichloride	17
Dichloroethene	Dichloroethylene	17
Dichloroether	Dichloroethyl ether	14, 17
Dichloroethylarsine		24, 107
Ethyl dichlorosilane		107
Ethyl ether	Dichloroether	14, 17
Dichloroisocyanuric acid	Dichloro-s-triazine-2, 4, 5-trion	104
Dichloromethane	Methylene chloride	17
Dichlorophene		17
Dichlorophenol		17, 31
Dichlorophenoxyacetic acid	2, 4-D	3, 17
Dichloropropane	Propylene dichloride	17
Dichloropropanol		4, 17
Dichloropropene	Dichloropropylene	17
Dichloropropylene	Dichloropropene	17
Dichloro-s-triazine-2, 4, 5-trione	Dichloroisocyanuric acid	104
Dichlorovos	DDVP	17, 32
Dicumyl peroxide		30
Dicyclopentadiene		28
Dieldrin		17
Diethanolamine		4, 7
Diethyl aluminum chloride	Aluminum diethylmonochloride, DEAL	105, 107
Diethylamine		7
Diethyl benzene		16
Diethyl chlorovinyl phosphate	Compound 1836	17, 32
Diethyl dichlorosilane		107
Diethylene dioxide	Dioxane	14
Diethylene glycol dinitrate		27, 102
Diethylene glycol monobutyl ether acetate		13
Diethylene triamine		7
Diethyl ether		14
Diethyl ketone		19
Diethyltoluamide		6
Diethyl zinc	Zinc ethyl	24, 105, 107
Diesel oil		101
Difluorophosphoric acid		1
Diglycidyl ether	Bis(2, 3-epoxypropyl) ether	34
Diisobutylene		28
Diisobutyl ketone		19
Diisopropanolamine		4, 17
Diisopropylbenzene hydroperoxide		30
Diisopropyl beryllium		24, 104, 107
Diisopropyl ether	Isopropyl ether	14
Diisopropyl peroxydicarbonate	Isopropyl percarbonate	30

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Dimecron*	Phosphamidon	32
Dimefox	Hanane*	6, 32
Dimethyl acetylene		28
Dimethyl amine		7
Dimethylamino azobenzene	Methyl yellow	7, 8
Dimethyl arsenic acid	Cacodylic acid	24
Dimethylbenzyl hydroperoxide	Cumene hydroperoxide	30
Dimethyl butane	Neohexane	29
Dimethyl butyne		28
Dimethyl dichlorosilane	Dichlorodimethylsilane	107
Dimethyldithiophosphoric acid		32
Dimethyl ether		14
Dimethyl formal		19
Dimethyl formamide		6
Dimethylhexane ditybroperoxide		30
Dimethyl hydrazine	UDMH	8
Dimethyl ketone	Acetone	19
Dimethyl magnesium		105, 107
Dimethylnitrobenzene	Nitroxylen	27
Dimethylnitrosoamine	N-Nitrosodimethylamine	7, 27
Dimethyl sulfide	Methyl sulfide	20
Dimeton		32
Dinitrobenzene		27
Dinitrochlorobenzene	Chlorodinitrobenzene	17, 27
2, 4-Dinitro-6-sec-butyl phenol	Dinoseb	27, 31
Dinitrocresol	DNOC, Elgetol 30	27, 31
Dinitrophenol		27, 31
Dinitrophenyl hydrazine		8, 27
Dinitrotoluene		27
Dinoseb	2, 4-Dinitro-6-sec-butyl phenol	27, 31
Dioxacarb		9
Dioxane	Diethylene dioxide	14
Dioxathion	Delnav*	32
Dipentaerythritol hexanitrate		27, 102
Dipentene		28
Diphenamide		6
Diphenyl	Phenylbenzene	16
Diphenyl acetylene		16
Diphenylamine		7
Diphenylamine chloroarsine	Phenarsazine chloride	7, 24
Diphenyl ethane		16
Diphenyl ethylene	Stilbene	16
Diphenyl methane	Benzylbenzene	16
Diphenylmethane diisocyanate		18, 107
Diphenyl oxide		14
Dipicryl amine	Hexanitrodiphenylamine	7, 27, 102
Dipropyl amine		7

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Disulfoton	Disyston*	32
Disulfuric acid		1
Disulfur dinitrid		25, 102
Disulfuryl chloride		107
Disyston*	Disulfoton	32
Dithane* M-45		12
Dithione*	Sulfotepp	32
DNOC	Dinitrocresol	27, 31
Dodecene		28
Dodecyl benzene		16
Dodecyl trichlorosilane		107
Dowco-139*	Mexacarbate	9
Dowicide 1	o-Phenyl phenol	31
Dowtherm		16
Durene		16
Dyfonate*	Fonofos	32
Dynes Thinner		101
Elgetol 30	Dinitrocresol	27, 31
Endolsulfan	Thiodan*	17, 20
Endothall		3
Endothion	Exothion	32
Endrin		17
EPN		32
Epichlorohydrin	Chloropropylene oxide	17, 34
Epoxybutane		34
Epoxybutene		34
Epoxyethane	Ethylene oxide	34, 103
Epoxyethylbenzene		34
Bis (2-3-Epoxypropyl) ether	Diglycidyl ether	34
Ethane		29
Ethanethiol	Ethyl mercaptan	20
Ethanol	Ethyl alcohol	4
Ethion*	Nialate	32
Ethoxyethanol		4, 14
Ethyl acetate		13
Ethyl acetylene		28
Ethylacrylate		13, 103
Ethyl alcohol	Ethanol	4
Ethylamine	Aminoethane	7
Ethyl benzene	Phenylethane	16
Ethyl butanoate	Ethyl butyrate	13
Ethyl butyrate	Ethyl butanoate	13
Ethyl chloride	Chloroethane	17
Ethyl chloroformate		13, 17
Ethyl dichloroarsine	Dichloroethylarsine	24, 107
Ethyl dichlorosilane		107
Ethyl ether	Diethyl ether	14

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Ethylene		28
Ethylene chromic oxide		24, 104
Ethylene chlorohydrin		4, 17
Ethylene cyanohydrin	Hydroxypropionitrile	4, 26
Ethylene diamine		7
Ethylene dibromide	Dibromoethane	17
Ethylene dichloride	Dichloroethane	17
Ethylene glycol		4
Ethylene glycol dinitrate	Glycol dinitrate	27, 102
Ethylene glycol monomethyl ether		4, 14, 17
Ethyleneimine	Aziridine	7, 103
Ethylene oxide	Epoxyethane	34, 103
Ethyl formate		13
2-Ethynexyl acrylate		13, 103
Ethyl mercaptan	Ethanethiol	20
Ethyl nitrate		27, 102
Ethyl nitrite		27, 102
Ethyl propionate		13
Ethyl trihalorosilane		107
Exothion	Endothion	32
Eugenol		31
Fensulfothion	Bayer 25141, Dasanit*	32
Ferbam		12
Ferric arsenate		24
Ferric sulfide		33
Ferrous arsenate	Iron arsenate	24
Ferrous sulfide		33, 105
Fluoranthrene		16
Fluorene		16
Fluorine		104, 107
Fluorine azide		102
Fluorine monoxide	Oxygen difluoride	104, 107
Fluoroacetanilide		6, 17
Fluoroacetic acid		3
Fluoroboric acid		1, 15
Fluorosulfonic acid	Fluosulfonic acid	1, 107
Fluosulfonic acid	Fluosulfonic acid	1, 107
Fluosilicic acid		1, 15
Fonofos*	Dyfonate*	32
Formaldehyde	Methanal	5
Formamide		6
Formetanate hydrochloride		6
Formic acid	Methanoic acid	3
Fostion*	Prothoate	32
Freon*		17
Fumaric acid		3
Fumarin	Coumafuryl	19

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Fumazone*	Dibromochloropropane	17
Furadan*	Carbofuran	9
Furan	Furfuran	14
Furfural		5
Furfuran		14
Gas oil, cracked		101
Gasoline		101
Germanium sulfide		33, 105
Glutaraldehyde		5
Glycerin		4
Glycidol		34
Glycol diacetate		13
Glycol dinitrate	Ethylene glycol dinitrate	27, 102
Glycol ether		14
Glycolic acid		3
Glycol monolactate trinitrate		27, 102
Glycolonitrile		26
Gold acetylide		105, 107
Gold cyanate	Gold fulminate	102
Gold fulminate	Gold cyanate	102
Gold sulfide		33, 105
Grease		101
Guaiacol		31
Guanyl nitrosaminoguanilydene hydrazine		8, 102
Guanidine nitrate		27, 104
Gun cotton	Nitrocellulose	27, 102
Guthion*		32
Hafnium		22
Hanane*	Dimefox	6, 32
Hemimellitene		16
Heptachlor		17
Heptane		29
Heptanal		5
Heptanol		4
Heptanone		19
Heptene		28
Hexaborane		105
Hexachlorobenzene		17
Hexadecyl trichorosilane		107
Hexaethyl tetraphosphate		32
Hexafluorophosphoric acid		1, 15
Hexahydride diborane	Diborane	105, 107
Hexamethyl benzene		16
Hexamethylenediamine	Diaminohexane	7
Hexamethylenetetraamine		7
Hexanal		5
Hexanitrodiphenylamine	Dipcrylamine	7, 27, 102

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Hexanol		4
Hexanoic acid	Caproic acid	3
Hexene		28
Hexylamine	Aminohexane	7
Hexyl trichlorosilane		107
Hexyne		28
HMX		102
Hopcide*		9
Hydrated lime	Calcium hydroxide	10
Hydrazine	Diamine	8, 105
Hydrazine azide		8, 102
Hydrazoic acid	Hydrogen azide	102
Hydriodic acid	Hydrogen iodide	1
Hydrobromic acid	Hydrogen bromide	1, 107
Hydrochloric acid	Muriatic acid	1
Hydrocyanic acid	Hydrogen cyanide	1, 11
Hydrofluoric acid	Hydrogen fluoride	1, 15
Hydrogen azide	Hydrazoic acid	102
Hydrogen bromide	Hydrobromic acid	1, 107
Hydrogen cyanide	Hydrocyanic acid	1, 11
Hydrogen fluoride	Hydrofluoric acid	1, 15
Hydrogen iodide	Hydroiodic acid	1
Hydrogen peroxide		104
Hydrogen phosphide	Phosphine	105
Hydrogen selenide		24, 105
Hydrogen sulfide		33, 105
Hydrouinone		31
Hydroxyacetophenone		19, 31
Hydroxydibromobenzoic acid		3, 17
Hydroxydiphenol		31
Hydroxyhydroquinone		31
Hydroxyacetophenone		19, 31
Hydroxyisobutyronitrile	Acetone cyanohydrin	4, 26
Hydroxyl amine		105
Hydroxyproponitrile	Ethylene cyanohydrin	4, 26
Hypochlorous acid		2
Indene		16
Indium		22, 23, 24
Inerteen	Polychlorinated biphenyl	17
Iodine monochloride		107
Iodine pentoxide		104
Iron		23
Iron arsenate	Ferrous arsenate	24
Isobutane		29
Isobutanol		4
Isobutyl acetate		13
Isobutyl acrylate		13, 103

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Isobutylene		28
Isodecyl acrylate		13
Isodurene		16
Isoeugenol		31
Isohexane		29
Isooctane	Trimethylpentane	29
Isooctene		28
Isopentane	Methylbutane	29
Isophorone		19
Isoprene	Methyl butadiene	28, 103
Isopropanol		4
Isopropyl acetate		13
Isopropyl acetylene		28
Isopropylamine	Aminopropane	7
Isopropyl benzene	Cumene	16
Isopropyl chloride	Chloropropane	17
Isopropyl ether	Diisopropyl ether	14
Isopropyl mercaptan		20
N-Isopropylmethylcarbamate		9
a-Isopropyl methylphosphoryl fluoride		17, 32
Isopropyl percarbonate	Diisopropyl peroxydicarbonate	30
Isotactic propylene		101
J-100		101
Jet oil		101
Kerosene		101
Lacquer thinner		101
Landrin*		9
Lannate*	Methomyl	9, 20
Lauroyl peroxide		30
Lead		23, 24
Lead acetate		24
Lead arsenate	Lead orthoarsenate	24
Lead arsenite		24
Lead azide		24, 102
Lead carbonate		24
Lead chlorite		24, 104
Lead cyanide		11, 24
Lead dinitroresorcinat		24, 27, 102
Lead mononitroresorcinat		24, 27, 102
Lead nitrate		24, 104
Lead orthoarsenate	Lead arsenate	24
Lead oxide		24
Lead styphnate	Lead trinitroresorcinat	24, 27, 102
Lead sulfide		24, 33, 104
Lead trinitroresorcinat	Lead styphnate	24, 27, 102
Lewisite	B-Chlorovinylchloroarsine	24
Lime nitrate	Calcium nitrate	104

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Lindane		17
Lithium		21, 107
Lithium aluminum hydride		105, 107
Lithium amide		10, 107
Lithium ferrosilicon		107
Lithium hydride		105, 107
Lithium hydroxide		10
Lithium hypochlorite		104
Lithium nitride		25
Lithium peroxide		104, 107
Lithium silicon		107
Lithium sulfide		33, 105
London purple		24
Lye	Sodium hydroxide	10
Magnesium		21, 22
Magnesium arsenate		24
Magnesium arsenite		24
Magnesium chlorate		104
Magnesium fluoride		15
Magnesium nitrate		104
Magnesium perchlorate		104
Magnesium peroxide		104
Magnesium sulfide		33, 105
Malathion		32
Maleic acid		3
Malonic nitrile	Cyanoacetic acid	3, 26
Maneb		12
Manganese		22, 23, 24
Manganese acetate		24
Manganese arsenate	Manganous arsenate	24
Manganese bromide	Manganous bromide	24
Manganese chloride	Manganous chloride	24
Manganese methylcyclopentadienyltricarbonyl		24
Manganese nitrate	Manganous nitrate	24, 104
Manganese sulfide		24, 33, 105
Manganous arsenate	Manganese arsenate	24
Manganous bromide	Manganese bromide	24
Manganous chloride	Manganese chloride	24
Manganous nitrate	Manganese nitrate	104
Mannitol hexanitrate	Nitromannite	27, 102
Matacil*		9
Mayer's reagent	Mercuric potassium iodide	24
Medinoterb acetate		13, 27
Meobal		9
Mercaptobenzothiazole		8, 20
Mercatoethanol		4, 20

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Mercarbam		32
Mercuric acetate		24
Mercuric ammonium chloride	Mercury ammonium chloride	24
Mercuric benzoate	Mercury benzoate	24
Mercuric bromide		24
Mercuric chloride	Mercury chloride	24
Mercuric cyanide	Mercury cyanide	11, 24
Mercuric dioxysulfate	Mercuric subsulfate	24
Mercuric iodide	Mercury iodide	24
Mercuric nitrate	Mercury nitrate	24, 104
Mercuric oleate	Mercury oleate	24
Mercuric oxide		24
Mercuric oxycyanide		11, 24, 102
Mercuric potassium iodide	Mayer's reagent	24
Mercuric salicylate	Salicylated mercury	24
Mercuric subsulfate	Mercuric dioxysulfate	24
Mercuric sulfate	Mercury sulfate	24
Mercuric sulfide		24, 33, 105
Mercuric thiocyanate	Mercury thiocyanide	24
Mercuric thiocyanide	Mercury thiocyanate	24
Mercuriol	Mercury nucleate	24
Mercurous bromide		24
Mercurous gluconate		24
Mercurous iodide		24
Mercurous nitrate		24, 104
Mercurous oxide		24
Mercurous sulfate	Mercury bisulfate	24
Mercury		24
Mercury (vapor)		22, 24
Mercury acetate	Mercuric acetate	24
Mercury ammonium chloride	Mercuric ammonium chloride	24
Mercury benzoate	Mercuric benzoate	24
Mercury bisulfate	Mercurous sulfate	24
Mercury chloride	Mercuric chloride	24
Mercury cyanide	Mercuric cyanide	11, 24
Mercury fulminate		24, 102
Mercury iodide	Mercuric iodide	24
Mercury nitrate	Mercuric nitrate	24, 104
Mercury nucleate	Mercuriol	24
Mercury oleate	Mercuric oleate	24
Mercury sulfate	Mercuric sulfate	24
Mesitylene	1, 3, 5-trimethylbenzene	16
Mesityl oxide		19
Mesurol*		9
Metasystox-R	Demeton-S-methyl sulfoxid	32
Metham		12
Methanal	Formaldehyde	5

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Methane		29
Methanethiol	Methyl mercaptan	20
Methanoic acid	Formic acid	3
Methanol	Methyl alcohol	4
Methomyl	Lannate*	9, 20
Methoxyethylmercuric chloride	Agallolaretan*	24
Methyl acetate		13
Methyl acetone		101
Methyl acetylene	Methyl butane	28
Methyl acrylate		13, 103
Methyl alcohol	Methanol	4
Methyl aluminum sesquibromide		105, 107
Methyl aluminum sesquichloride		105, 107
Methylamine	Aminomethane	7
Methyl amyl acetate		13
N-Methyl aniline		7
Methyl aziridine	Propyleneimine	7
Methyl benzene	Toluene	16
Methyl bromide	Bromomethane	17
Methyl butadiene	Isoprene	28, 103
Methyl butane	Isopentane	29
Methyl butene		28
Methyl butyl ether		14
Methyl t-butyl ketone		19
Methyl butyne	Isoprpl acetylene	28
Methyl butyrate		13
Methyl chloride	Chloromethane	17
Methyl chlorocarbonate	Methyl chloroformate	13, 17
Methyl chloroform		17
Methyl chloroformate	Methyl chlorocarbonate	13, 17
Methyl chloromethyl ether	CMME	14, 17
Methyl cyanide	Acetonitrile	26
Methyl cyclohexane		29
Methyl dichloroarsine		24
Methyl dichlorosilane		107
Methylene chloride	Dichloromethane	17
Methylene diisocyanate		18, 107
4, 4-Methylene bis (2-chloroaniline)		7, 17
Methyl ethyl chloride		17
Methyl ethyl ether		14
Methyl ethyl ketone	Butanone	19
Methyl ethyl ketone peroxide		30
Methyl ethyl pyridine		7
Methyl formate		13
Methyl hydrazine	Monomethyl hydrazine	8
Methyl iodide		17
Methyl isobutyl ketone		19

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Methyl isocyanate		18, 107
Methyl isopropenyl ketone		19
Methyl magnesium bromide		105, 107
Methyl magnesium chloride		105, 107
Methyl magnesium iodide		105, 107
Methyl mercaptan	Methanethiol	20
Methyl methacrylate		13, 103
Methyl naphthalene		16
Methyl parathion		32
Methyl pentanoate	Methyl valerate	13
Methyl propionate		13
Methyl n-propyl ketone		19
Methyl styrene		28, 103
Methyl sulfide	Dimethyl sulfide	20
Methyl trichlorosilane		107
Methyl valerate	Methyl pentanoate	13
Methyl vinyl ketone	Butene-2-one	19
Methyl yellow	Dimethylamino azobenzene	7, 8
Mevinphos	Phosdrin*	32
Mexacarbate	Dowco-139*	9
Mineral spirits		101
Mintacol*	Paraoxon	32
Mipcin*		9
Mobam*		9
Mocap*		32
Molybdenum		22, 23, 24
Molybdenum anhydride	Molybdenum trioxide	24
Molybdenum sulfide		24, 33, 105
Molybdenum trioxide	Molybdenum anhydride	24
Molybdic acid		24
Monochloroacetone	Chloroacetone	17, 19
Monochloroacetic acid	Chloroacetic acid	3, 17
Monocrotophos	Azodrin*	32
Monoethanol amine		4, 7
Monofluorophosphoric acid		1
Monoisopropanolamine		4, 7
Monomethyl hydrazine	Methyl hydrazine	8
Morpholine		7
Municipal solid waste	Refuse	101
Muriatic acid	Hydrochloric acid	1
Nabam		12
Nack	Sodium-potassium alloy	21, 107
Nak	Sodium-potassium alloy	21, 107
Naptha		101
Napthalene		16
Naphthol		31
Naphthylamine		7

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Naphthyl mercaptan		20
Naphtite	Trinitronaphthalene	27, 102
Nemagon*	Dibromochloropropane	17
Neohexane	Dimethyl butane	29
4-NBP	Nitrobiphenyl	27
Niacide*		12
Nialate	Ethion	32
Nickel		22, 24
Nickel acetate		24
Nickel antimonide		24, 107
Nickel arsenate	Nickelous arsenate	24
Nickel arsenite	Nickelous arsenite	24
Nickel carbonyl	Nickel tetracarbonyl	24
Nickel chloride	Nickelous chloride	24
Nickel cyanide		11, 24
Nickel nitrate	Nickelous nitrate	24, 104
Nickelous arsenate	Nickel arsenate	24
Nickelous arsenite	Nickel arsenite	24
Nickelous chloride	Nickel chloride	24
Nickelous nitrate	Nickel nitrate	24, 104
Nickel selenide		24
Nickel subsulfide		24, 33, 105
Nickel sulfate		24
Nickel tetracarbonyl	Nickel carbonyl	24
Nitraniline	Nitroaniline	7, 27
Nitric acid		2
Nitroaniline	Nitraniline	7, 27
Nitrobenzene	Nitrobenzol	27
Nitrobenzol	Nitrobenzene	27
Nitrobiphenyl	4-NBP	27
Nitrocalcium	Calcium nitrate	104
Nitrocellulose	Cellulose nitrate, gun cotton	27, 102
Nitrochlorobenzene	Chloronitrobenzene	17, 27
Nitrogen dioxide		104
Nitromannite	Mannitol hexanitrate	27, 102
Nitrogen mustard		7, 17
Nitrogen tetroxide		104
Nitroglycerin	Trinitroglycerin	27, 102
Nitrohydrochloric acid		2
Nitrophenol		27, 31
Nitropropane		27
Nitrosodimethylamine	Dimethylnitrosoamine	7, 27
Nitrosoguanidine		27, 102
Nitrostarch	Starch nitrate	27, 102
Nitroxylenes	Nitroxylol, Dimethylnitrobenzene	27
Nitroxylol	Nitroxylenes, Dimethylnitrobenzene	27
N-Nitrosodimethylamine	Dimethylnitrosoamine	7, 27

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Nonyl phenol		31
Nonyl trichlorosilane		107
Nonane		29
Nonene		28
Nonanone		19
Nonanal		5
Nonanol		4
Octadecyl trichlorosilane		107
Octadecyne		28
Octamethylpyrophosphoramidate	Schradan	6, 32
Octanal		5
Octane		29
Octanone		19
Octanol		4
Octene		28
Octyl peroxide	Caprylyl peroxide	30
Octyl trichlorosilane		107
Oil of bergamot		101
Oil of vitriol	Sulfuric acid	1
Oleum	Sulfuric acid	2, 24
Orris root		101
Orthozenol	o-Phenyl phenol	31
Osmium		23, 24
Osmium amine nitrate		24, 104
Osmium amine perchlorate		24, 104
Oxamyl		9
Oxalic acid		3
Oxygen difluoride		104, 107
PCB	Polychlorinated biphenyl	17
Paper		101
Paraxon	Mintacol*	32
Parathion		32
Paris green	Copper acetoarsenite	24
PETD	Polyram combi*	12
PETN	Pentaerythrityl tetranitrate, Pentaerythritol tetranitrate	27, 102
Pentaborane		105
Pentachlorophenol		17, 31
Pentaerythritol tetranitrate	Pentaerythritol tetranitrate, PETN	27, 102
Pentamethyl benzene		16
Pentane		29
Pentanethiol	Amyl mercaptan	20
Pentnal	Valeraldehyde	5
Pentanone		19
Pentene	Amylene	28
Pentylamine		7
Pentyne		28

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Peracetic acid	Peroxyacetic acid	3, 30
Perbromic acid		2
Perchloric acid		2
Perchloroethylene	Tetrachloroethylene	17
Perchloromethyl mercaptan	Trichloromethylsulfenylchloride	17, 20
Perchlorous acid		2
Perchloryl fluoride		104
Periodic acid		2
Permonosulfuric acid		1
Peroxyacetic acid	Peracetic acid	3, 30
PETD	Polyram combi*	12
Petroleum naptha		101
Petroleum oil		101
Phenanthrene		16
Phenarsazine chloride	Diphenylamine chloroarsine	7, 24
Phenol	Carbolic acid	31
Phenyl acetic acid		3
Phenyl acetonitrile		26
Phenyl acetylene		16
Phenylaniline	Diphenylamine	7
Phenylbenzene	Diphenyl	16
Phenylbutane	Butylbenzene	16
Phenylchloromethyl ketone	Chloroacetophenone	17, 19
Phenyl dichloroarsine		24
Phenylene diamine	Diaminobenzene	7
Phenylethane	Ethylbenzene	16
Phenyl hydrazine hydrochloride		8
o-Phenyl phenol	Orthozenol, Dowicide 1	31
Phenyl trichlorosilane		107
Phenyl valeryl nitrile		26
Phenylpropane	Propylbenzene	16
Phloroglucinol		31
Phorate	Thirnet*	32
Phosdrin*	Mevinphos	32
Phosphamidon	Dimecron*	32
Phosphine	Hydrogen phosphide	105
Phospholan	Cyolan*	20, 32
Phosphonium iodide		105, 107
Phosphoric acid		1
Phosphoric anhydride	Phosphorus pentoxide	107
Phosphoric sulfide	Phosphorus pentasulfide	33, 105, 107
Phosphorus (Amorphous red)		105, 107
Phosphorus (White-Yellow)		105
Phosphorus heptasulfide		33, 105
Phosphorus oxybromide	Phosphoryl bromide	104, 107
Phosphorus oxychloride	Phosphoryl chloride	104, 107
Phosphorus pentachloride	Phosphoric chloride	107

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Phosphorus pentasulfide	Phosphoric sulfide	33, 105, 107
Phosphorus pentoxide	Phosphoric anhydride	107
Phosphorus sesquisulfide	Tetraphosphorus trisulfide	33, 105, 107
Phosphorus tribromide		107
Phosphorus trichloride		107
Phosphorus trisulfide		33, 105, 107
Phosphoryl bromide	Phosphorous oxybromide	104, 107
Phosphoryl chloride	Phosphorus oxychloride	104, 107
Phthalic acid		3
Picramide	Trinitroaniline	7, 27, 102
Picric acid	Trinitrophenol	27, 31, 102
Picridine		7
Picryl chloride	Chlorotrinitrobenzene	17, 27, 102
Piperidine		7
Pirimicarb		9
Polyglycol ether		14
Polyamide resin		101
Polybrominated biphenyl		17
Polybutene		28
Polychlorinated biphenyls	PCB, Askarel, Arochlor*, Chlorextol, Inerteen	17
Polychlorinated triphenyls		17
Polyethylene		101
Polyester resin		101
Polymeric oil		101
Polyphenyl polymethylisocyanate		18, 107
Polypropylene		28, 101
Polyram combi*	PETD	12
Polysulfide polymer		20, 101
Polystyrene		101
Polyurethane		101
Polyvinyl acetate		101
Polyvinyl chloride		101
Polyvinyl nitrate		27, 102
Potasan		32
Potassium		21, 107
Potassium acid fluoride	Potassium fluoride	15
Potassium aluminate		10
Potassium arsenate		24
Potassium arsenite		24
Potassium bifluoride	Potassium fluoride	15
Potassium bichromate	Potassium dichromate	24, 104
Potassium bromate		104
Potassium butoxide		10
Potassium cyanide		11
Potassium dichloroisocyanurate		104
Potassium dichromate	Potassium bichromate	24, 104

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Potassium dinitrobenzfuroxan		27, 102
Potassium fluoride	Potassium acid fluoride	15
Potassium hydride		105, 107
Potassium hydroxide	Caustic potash	10
Potassium nitrate	Saltpeter	102, 104
Potassium nitride		25
Potassium nitrite		104
Potassium oxide		107
Potassium perchlorate		104
Potassium permanganate		24, 104
Potassium peroxide		104, 107
Potassium sulfide		33, 105
Promecarb		9
Propanal	Propionaldehyde	5
Propane		29
Propanethiol	Propyl mercaptan	20
Propanoic acid	Propionic acid	3
Propanol	Propyl alcohol	4
Propargyl bromide		17
Propargyl chloride		17
2-Propen-1-ol	Allyl alcohol	4
Propiolactone		13
Propionaldehyde	Propanal	5
Propionamide		6
Propionic acid	Propanoic acid	3
Propionitrile		26
Propyl acetate		13
Propyl alcohol	Propanol	4
Propylamine		7
Propyl benzene	Phenyl propane	16
Propylene dichloride	Dichloropropane	17
Propylene glycol		4
Propylene glycol monomethyl ether		4, 14
Propylene oxide		34, 103
Propyleneimine	Methyl aziridine	7
Propyl ether		14
Propyl formate		13
Propyl mercaptan	Propanethiol	20
Propyl trichlorosilane		107
Prothoate	Fostion*	32
Pseudocumene	1, 2, 4-Trimethylbenzene	16
Pyridine		7
Pyrogallol		31
Pyrosulfuryl chloride	Disulfuryl chloride	107
Pyroxylin	Collodion	27
Quinone	Benzoquinone	19
Raney nickel		22

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
RDX	Cyclotrimethylene trinitramine	27, 102
Refuse	Municipal solid waste	101
Resins		101
Resorcinol		31
Rubidium		21
Salicylated mercury	Mercuric salicylate	24
Saligenin		31
Salt peter	Potassium nitrate	102, 104
Schradan	Octamethyl pyrophosphoramidate, OMPA	6, 32
Selenious acid	Selenous acid	1, 24
Selenium		22, 23, 24
Selenium diethyldithiocarbamate		12, 24
Selenium fluoride		15, 24
Selenous acid	Selenious acid	1, 24
Silicochloroform	Trichlorosilane	107
Silicon tetrachloride		107
Silicon tetrafluoride		15, 107
Silver acetylide		24, 102, 105, 107
Silver azide		24, 102
Silver cyanide		11, 24
Silver nitrate		24, 104
Silver nitride		24, 25, 102
Silver styphnate	Silver trinitroresorcinate	24, 27, 102
Silver sulfide		24, 33, 105
Silver tetrazene		24, 102
Silver trinitroresorcinate	Silver styphnate	24, 27, 102
Slaked lime	Calcium oxide	10, 107
Smokeless powder		102
Sodamide	Sodium amide	10, 107
Soda niter	Sodium nitrate	104
Sodium		21, 105, 107
Sodium acid fluoride	Sodium fluoride	15
Sodium aluminate		10, 105
Sodium aluminum hydride		105, 107
Sodium amide	Sodamide	10, 107
Sodium arsenate		24
Sodium arsenite		24
Sodium azide		102
Sodium bichromate	Sodium dichromate	24, 104
Sodium bifluoride	Sodium fluoride	15
Sodium bromate		104
Sodium cacodylate	Sodium dimethylarsenate	24
Sodium carbonate		10
Sodium carbonate peroxide		104
Sodium chlorate		104
Sodium chlorite		104
Sodium chromate		24

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Sodium cyanide		11
Sodium dichloroisocyanurate		104
Sodium dichromate	Sodium bichromate	24, 104
Sodium dimethylarsenate	Sodium cacodylate	24
Sodium fluoride	Sodium acid fluoride	15
Sodium hydride		105, 107
Sodium hydroxide	Caustic soda, Lye	10
Sodium hypochlorite		10, 104
Sodium hyposulfite	Sodium thiosulfate	105
Sodium methylate	Sodium methoxide	10, 107
Sodium methoxide	Sodium methylate	10, 107
Sodium molybdate		24
Sodium monoxide	Sodium oxide	10, 107
Sodium nitrate	Soda niter	104
Sodium nitride		25
Sodium nitrite		104
Sodium oxide	Sodium monoxide	10, 107
Sodium pentachlorophenate		31
Sodium perchlorate		104
Sodium permanganate		24, 104
Sodium peroxide		104, 107
Sodium phenosulfonate		31
Sodium picramate		27, 102
Sodium polysulfide		101
Sodium potassium alloy	Nak, Nack	21, 107
Sodium selenate		24
Sodium sulfide		24, 33, 105
Sodium thiosulfate		105
Stannic chloride	Tin tetrachloride	24, 107
Stannic sulfide		33, 105
Starch nitrate	Nitrostarch	27, 102
Stilbene	Diphenyl ethylene	16
Stoddard solvent		101
Strontium		24
Strontium arsenate		24
Strontium dioxide	Strontium peroxide	24, 104
Strontium monosulfide		24, 33, 105
Strontium nitrate		24, 104
Strontium peroxide	Strontium dioxide	104
Strontium tetrasulfide		24, 33, 105
Styphnic acid	Trinitroresorcinol	27, 31, 102
Styrene	Vinylbenzene	16, 28, 103
Succinic acid		3
Succinic acid peroxide		30
Sulfonyl chloride	Sulfuryl chloride	107
Sulfonyl fluoride		107
Slfotepp	Dithione*, Blada-Fum*	32

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

<b>Names</b>	<b>Synonyms</b>	<b>RGN</b>
Sulfur chloride	Sulfur monochloride	107
Sulfur (elemental)		101
Sulfuric acid	Oil of Vitriol, Oleum	2, 107
Sulfuric anhydride	Sulfur trioxide	104, 107
Sulfur monochloride	Sulfur chloride	107
Sulfur mustard		20
Sulfur oxychloride		107
Sulfur pentafluoride	Thionyl chloride	15, 107
Sulfur trioxide	Sulfuric anhydride	104, 107
Sulfuryl chloride	Sulfonyl chloride	107
Sulfuryl fluoride	Sulfonyl fluoride	107
Supracide*	Ultracide*	32
Surecide*	Cyanophenphos	32
Synthetic rubber		101
TCDD	Tetrachlorodibenzo-p-dioxin	14, 17
TEDP	Tetraethyl dithionopyrophosphate	32
TEL	Tetraethyl lead	24
TEPA	Tris-(1-aziridinyl) phosphine oxide	6, 32
TEPP	Tetraethyl pyrophosphate	32
THF	Tetrahydrofuran	14
TMA	Trimethylamine	7
TML	Tetramethyl lead	24
TNB	Trinitrobenzene	27, 102
TNT	Trinitrotoluene	24, 102
Tall oil		101
Tallow		101
Tar		101
Tellurium hexafluoride		15, 24
Temik*	Aldicard	9, 20
Tetrabcrane		105
Tetrachlorodibenzo-p-dioxin	TCDD	14, 17
Tetrachloroethane		17
Tetrachloroethylene	Perchloroethylene	17
Tetrachloromethane	Carbon tetrachloride	17
Tetrachlorophenol		17, 31
Tetrachloropropyl ether		14, 17
Tetradecene		28
Tetraethyl dithionopyrophosphate	TEDP	32
Tetraethyl lead	TEL	24
Tetraethyl pyrophosphate	TEPP	32
Tetrahydrofuran	THF	14
Tetramethylenediamine		7
Tetramethyl lead	TML	24
Tetramethyl succinonitrile		26
Tetranitromethane		27, 102
Tetraphenyl ethylene		16
Tetraphosphorus trisulfide	Phosphorus sesquisulfide	33, 105, 107

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Tetraselenium tetranitride		24, 25, 102
Tetrasul	Animert* V-101	20
Tetrasulfur tetranitride		25, 102
Tetrazene		8, 102
Thallium		24
Thallium nitride		24, 25, 102
Thallium sulfide		24, 33, 105
Thallosulfate		24
Thimet*	Phorate	32
Thionyl chloride	Sulfur oxychloride	107
Thiocarbonyl chloride	Thiophosgene	107
Thiodan*	Endosulfan	17, 20
Thionazin	Zinophos*	32
Thionyl chloride	Sulfur oxychloride	107
Thiophosgene	Thiocarbonyl chloride	107
Thiophosphoryl chloride		107
Thiram		12
Thorium		22, 23, 24
Tin tetrachloride	Stannic chloride	24, 107
Titanic chloride	Titanium tetrachloride	24, 107
Titanium		22, 23, 24
Titanium sesquisulfide		24, 33, 105
Titanium sulfate		24
Titanium sulfide		24, 33, 105
Titanium tetrachloride	Titanic chloride	24, 107
TMA	Trimethylamine	7
TNB	Trinitrobenzene	27, 102
TNT	Trinitrotoluene	27, 102
Tolualdehyde		5
Toluene	Toluol, Methylbenzene	16
Toluene diisocyanate		18, 107
Toluic acid		3
Toluidine	Aminotoluene	7
Toluol	Toluene, Methylbenzene	16
Topcide*	Benzadox	6
Tranid*		9, 26
Triamphos	Wepsyn* 155	6, 32
Tribromomethane	Bromoform	17
Tri-n-butylaluminum		107
Tricadmium dinitride		24, 25
Tricalcium dinitride		25
Tricesium nitride		24, 25
Trichloroacetaldehyde	Chloral hydrate	5, 17
Trichloroborane		107
Trichloroethane		17
Trichloroethene	Trichloroethylene	17
Trichlorolsocyanuric acid		104

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Trichloromethane	Chloroform	17
Trichloromethyl sulfenyl chloride	Perchloromethyl mercaptan	17, 20
Trichloronitromethane	Chloropicrin	17, 27, 102
Trichlorophenoxyacetic acid		3, 17
Trichloropropane		17
Trichlorosilane	Silicochloroform	107
Tridecene		28
Triethanolamine		4, 7
Triethyl aluminum		105, 107
Triethyl antimony	Triethylstibine	24, 105, 107
Triethyl arsine		24, 107
Triethyl bismuthine		24
Triethylamine		7
Triethylene phosphoramidate	Tris (1-aziridinyl) phosphine oxide	6, 32
Triethylene tetraamine		7
Triethyl stibine	Triethyl antimony	24, 105, 107
Trifluoroethane		17
Trifluoromethylbenzene	Benzotrifluoride	17
Triisobutyl aluminum		105, 107
Trilead dinitride		24, 25, 102
Trimerccury dinitride		24, 25, 102
Trimethyl aluminum		105, 107
Trimethylamine	TMA	7
Trimethyl antimony	Trimethylstibine	24, 105
Trimethyl arsine		24, 107
1, 2, 4-Trimethylbenzene	Pseudocumene	16
1, 3, 5-Trimethylbenzene	Mesitylene	16
Trimethyl bismuthine		24
Trimethyl pentane	Isooctane	29
Trimethylstibine	Trimethyl antimony	24, 105, 107
Tri-n-butylborane		105, 107
Trinitroaniline	Picramide	7, 27, 102
Trinitroanisole	Trinitrophenylmethyl ether	14, 27
Trinitrobenzene	TNB	27, 102
Trinitrobenzoic acid		3, 27, 102
Trinitroglycerin	Nitroglycerin	27, 102
Trinitronaphthalene	Naphtite	27, 102
Trinitrophenol	Picric acid	27, 31, 102
Trinitrophenyl methyl ether	Trinitroanisole	14, 27
Trinitroresorcinol	Styphnic acid	27, 31, 102
Trinitrotoluene	TNT	27, 102
Trioctyl aluminum		105, 107
Triphenyl ethylene		16
Triphenyl methane		16
Tripropylamine		7
Tripropyl stibine		24, 107
Trisilyl arsine		24, 107

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Tris-(1-aziridiny) phosphine oxide	TEPA, Triethylene phosphoramidate	6, 32
Trithion		32
Trithorium tetranitride		24, 25
Trivinyl stibine		24, 107
Tsumacide*		9
Tungstic acid		24
Turpentine		101
UDMH	Dimethyl hydrazine	8
Ultracide*	Supracide*	32
Undecene		28
Unisolve		101
Uranium nitrate	Uranyl nitrate	24, 104
Uranium sulfide		24, 33, 105
Uranyl nitrate	Uranium nitrate	24, 104
Urea formaldehyde		5
Urea nitrate		27, 102, 104
VC	Vinylidene chloride	17, 103
Valeraldehyde	Pentanal	5
Valeramide		6
Valeric acid		3
Vanadic acid anhydride	Vanadium pentoxide	24
Vanadium oxytrichloride		24
Vanadium pentoxide	Vanadic acid anhydride	24
Vanadium sulfate	Vanadyl sulfate	24
Vanadium tetroxide		24
Vanadium trichloride		24, 107
Vanadium trioxide		24
Vanadyl sulfate	Vanadium sulfate	24
Vapona*	DDVP	32
Vinyl acetate		13, 103
Vinyl azide		102
Vinylbenzene	Styrene	16, 28, 103
Vinyl chloride		17, 103
Vinyl cyanide		26, 103
Vinyl ethyl ether		14
Vinyl isopropyl ether		17
Vinylidene chloride	VC	17, 103
Vinyl toluene		28, 103
Vinyl trichlorosilane		107
VX		20, 32
Water		106
Waxes		101
Wepsyn* 155	Triamiphos	6, 32
Wood		101
Zectran*	Dowco 139*	9
Zinc		22, 23, 24
Zinc acetylide		24, 105, 107

**Table 670-A-1. CHEMICAL SUBSTANCES - Continued**

Names	Synonyms	RGN
Zinc ammonium nitrate		24, 104
Zinc arsenate		24
Zinc arsenite		24
Zinc chloride		24
Zinc dioxide	Zinc peroxide	24, 102, 104, 107
Zinc ethyl	Deithyl zinc	24, 105, 107
Zinc cyanide		11, 24
Zinc fluoborate		24, 15
Zinc nitrate		24, 104
Zinc permanganate		24, 102, 104, 107
Zinc peroxide	Zinc dioxide	24, 107
Zinc phosphide		12, 24
Zinc salts of dimethyl dithiocarbamic acid		
Zinc sulfate		24
Zinc sulfide		24, 33, 105
Zineb*		12, 24
Zinophos*	Thioazin	20
Ziram*		12, 24
Zirconium		22, 23, 24
Zirconium chloride	Zirconium tetrachloride	24
Zirconium picramate		24, 104
Zirconium tetrachloride	Zirconium chloride	24

**Table KEY TO FIGURE 670-A-1. KEY TO FIGURE 670-A-1.  
HAZARDOUS MATERIALS COMPATIBILITY LIST**

RG NO.	MATERIAL	CONTACTING RG	REACTION CODES
1	ACIDS MINERAL NON-OXIDIZING	1	NONE
2	ACIDS MINERAL OXIDIZING	2	NONE
3	ACIDS ORGANIC	2	H, G
4	ALCOHOLS AND GLYCOLS	1 2 3	H H, F H, P
5	ALDEHYDES	1 2 3	H, P H, P H, P
6	AMIDES	1 2	H H, GT
7	AMINES ALIPHATIC AND AROMATIC	1 2 3 5	H H, GT H H
8	AZO COMPOUNDS DIAZO COMPOUNDS AND HYDRAZINES	1 2 3 4	H, G H, GT H, G H, G

**Table KEY TO FIGURE 670-A-1. KEY TO FIGURE 670-A-1.****HAZARDOUS MATERIALS COMPATIBILITY LIST - Continued**

<b>RG NO.</b>	<b>MATERIAL</b>	<b>CONTACTING RG</b>	<b>REACTION CODES</b>
9	CARBAMATES	1	H, G
		2	H, GT
		8	G, H
10	CAUSTICS	1	H
		2	H
		3	H
		5	H
		9	H, G
11	CYANIDES	1	GT,GF
		2	GT, GF
		3	GT, GF
12	DITHIOCARBAMATES	1	H, GF, P
		2	H, GF, F
		3	H, GF, GT
		5	GF, GT
		7	U
		8	HG
13	ESTERS	1	H
		2	H, P
		8	H, G
		10	H
14	ETHERS	1	H
		2	H, F
15	FLUORIDES INORGANIC	1	GT
		2	GT
		3	GT
16	HYDROCARBONS AROMATIC	1	H
		2	HF
17	HALOGENATED ORGANICS	1	H, GT
		2	H, F, GT
		7	H, GT
		8	H, G
		10	H, GF
		11	H
18	ISOCYANATES	1	H, G
		2	GT
		3	HG
		4	HP
		7	HP
		8	HG
		9	H
		10	PG
		11	HG
		12	U

**Table KEY TO FIGURE 670-A-1. KEY TO FIGURE 670-A-1.****HAZARDOUS MATERIALS COMPATIBILITY LIST - Continued**

<b>RG NO.</b>	<b>MATERIAL</b>	<b>CONTACTING RG</b>	<b>REACTION CODES</b>
19	KETONES	1 2 8 10 11	H H, F H, G H H
20	MERCAPTANS AND OTHER SULPHIDES	1 2 8 17 18 19	GT, GF H, F GT H, G H H H
21	METALS, ALKALI AND ALKALINE EARTH, ELEMENTAL	1 2 3 4 5 6 7 8 9 10 11 12 13 17 18 19 20	GM, F, H GF, H, F GF, H, F GF, H, F G, H, F GF, H GF, H GF, H GF, H GF, H GF, H GF, H GF, H HE GF, H GF, H GF, H
22	METALS, OTHER ELEMENTAL AND POWDERS, VAPORS OR SPONGES	1 2 3 8 9 10 17 18 20	GF, H, F GF, F, H GF H, F, GT U GF, H H, E HF, H H, GF, F
23	METALS, OTHER ELEMENTAL ALLOYS AS SHEETS, RODS, DROPS, MOULDINGS ETC.	1 2 8 17	GF, H, F, GF, H, F H, F, G H,F
24	METALS, AND METAL COMPOUNDS, TOXIC	1	E

**Table KEY TO FIGURE 670-A-1. KEY TO FIGURE 670-A-1.**

## HAZARDOUS MATERIALS COMPATIBILITY LIST - Continued

RG NO.	MATERIAL	CONTACTING RG	REACTION CODES
		2 3 6 7 10	E E E E E
25	NITRIDES	1 2 3 4 8 9 10 11 12 13 17 18 19 20 21	GF, HP H, F, E H, GF GF, H, E U H, G U GF, H GF, H GF, H GF, H U GF, H GF, H E
26	NITRILES	1 2 3 10 21 24 25	H, GT, GF H, GT, F H H HP S GF, H
27	NITRO COMPOUNDS ORGANIC	2 5 10 21	H, F, GT H H, E H, GF, E
28	HYDROCARBONS ALIPHATIC UNSATURATED	1 2 5 22	H H, F H H, E
29	HYDROCARBONS ALIPHATIC SATURATED	2	H, F
30	PEROXIDES AND HYDROPEROXIDES ORGANIC	1 2 4 5 7 8 9 11	H, G H, E H, F H, G H, GT H, F, E H, F, GT H, E, GT

**Table KEY TO FIGURE 670-A-1. KEY TO FIGURE 670-A-1.****HAZARDOUS MATERIALS COMPATIBILITY LIST - Continued**

<b>RG NO.</b>	<b>MATERIAL</b>	<b>CONTACTING RG</b>	<b>REACTION CODES</b>
		12 17 18 19 20 21 22 24 25 26 28	H, F, GT H, E H E H, F, GT H, E H, G H, G H, GF, E H, F, GT H, P
31	PHENOLS AND CRESOLS	1 2 8 18 21 25 30	H P H, G H, P GF, H GF, H H
32	ORGANOPHOSPHATES, THIOPHOSPHATES AND PHOSPHODITHIOATES	1 2 8 10 21 30	H, GT H, GT U H, E H U
33	SULPHIDES INORGANIC	1 2 3 5 8 18 30	GT, GP HF, GT GT H E H H, GT
34	EPOXIDES	1 2 3 4 5 7 8 10 11 12	H, P H, P H, P H, P U H, P H, P H, P H, P U
101	COMBUSTIBLE AND FLAMMABLE MATERIALS	1 2 21	H, G H, F, GT H, G, F

**Table KEY TO FIGURE 670-A-1. KEY TO FIGURE 670-A-1.****HAZARDOUS MATERIALS COMPATIBILITY LIST - Continued**

<b>RG NO.</b>	<b>MATERIAL</b>	<b>CONTACTING RG</b>	<b>REACTION CODES</b>
		25 30	H, GF, F H, F, GT
102	EXPLOSIVES	1 2 3 8 10 13 21 22 23 24 25 30 31 33 34 101	H, E H, E H, E H, E H, E H, E H, E H, E E E H, E H, E H, E H, E H, E
103	POLYMERIZABLE COMPOUNDS	1 2 3 8 10 11 12 21 22 23 24 25 30 31 33 102	P, H P, H P, H P, H P, H P, H U H, P H, P H, P H, P H, P H, P H, P H, P
104	OXIDIZING AGENTS STRONG	1 3 4 5 6 7 8 9 11 12	H, GT H, GT H, F H, F H, F, E H, F, E H, E H, F, E H, G, E H, G, E

**Table KEY TO FIGURE 670-A-1. KEY TO FIGURE 670-A-1.**

## HAZARDOUS MATERIALS COMPATIBILITY LIST - Continued

RG NO.	MATERIAL	CONTACTING RG	REACTION CODES
		13	H, F
		14	H, F
		16	H, F
		17	H, GT
		18	GT, F, H
		19	H, F
		20	H, F, GT
		21	H, F, E
		22	H, F, E
		23	H, F
		25	H, F, E
		26	H, F, GT
		27	H, E
		28	H, F
		29	H, F
		30	H, G
		31	H, F
		32	H, F, GT
		33	H, F, G
		34	H, F, G
		101	H, G, E
		102	H, GT
		103	H, F
105	REDUCING AGENTS STRONG	1	H, GF
		2	H, F, GT
		3	H, GF
		4	H, GF, E
		5	GF, H, F
		6	H, GF
		7	H, GF
		8	HG
		12	H, GT
		13	H, F
		17	H, E
		18	GF, H
		19	GF, H
		20	GF, H
		26	H, GF
		27	H, E
		30	H, E
		31	GF, H
		32	GT, GF, H
		34	H
		101	GF, H

**Table KEY TO FIGURE 670-A-1.** KEY TO FIGURE 670-A-1.

## HAZARDOUS MATERIALS COMPATIBILITY LIST - Continued

RG NO.	MATERIAL	CONTACTING RG	REACTION CODES
		102 103 104	H, E F, P, GF H, F, P
106	WATER AND MIXTURES CONTAINING WATER	1 2 8 17 21 22 24 25 33 105	H H G H, E GF, H GF, H S GF, H GT, GF GF, GT
107	WATER REACTIVE SUBSTANCES	1 TO 107	EXTREMELY REACTIVE. DO NOT MIX WITH ANY CHEMICAL.

REACTIVITY GROUP NO.	REACTIVITY GROUP NAME
1	ACIDS MINERAL NON-OXIDIZING
2	ACIDS MINERAL OXIDIZING
3	ACIDS ORGANIC
4	ALCOHOLS AND GLYCOLS
5	ALDEHYDES
6	AMIDES
7	AMINES ALIPHATIC AND AROMATIC
8	AZO COMPOUNDS DIAZO COMPOUNDS AND HYDRAZINES
9	CARBAMATES
10	CAUSTICS
11	CYANIDES
12	DITHIOCARBAMATES
13	ESTERS
14	ETHERS
15	FLOURIDES INORGANIC
16	HYDROCARBONS AROMATIC
17	HALOGENATED ORGANICS
18	ISOCYANATES
19	KETONES
20	MERCAPTANS AND OTHER SULPHIDES
21	METALS, ALKALI AND ALKALINE EARTH, ELEMENTAL
22	METALS, OTHER ELEMENTAL AND ALLOYS AS POWDERS, VAPORS OR SPONGES
23	METALS, OTHER ELEMENTAL ALLOYS AS SHEETS, RODS, DROPS, MOLDINGS
24	METALS AND METAL COMPOUNDS, TOXIC
25	NITRIDES
26	NITRILES
27	NITRO COMPOUNDS ORGANIC
28	HYDROCARBONS ALIPHATIC UNSATURATED
29	HYDROCARBONS SATURATED
30	PEROXIDES HYDROPEROXIDES ORGANIC
31	PHENOLS AND CRESOLS
32	ORGANO-PHOSPHATES, THIOPHOSPHATES AND PHOSPHONATES
33	SULPHIDES INORGANIC
34	EPOXIDES
35	COMBUSTIBLE AND FLAMMABLE MATERIALS
36	EXPLOSIVES
37	POLYMERIZABLE COMPOUNDS
38	Oxidizing Agents Strong
39	Reducing Agents Strong
40	Water And Mixtures Containing Water
41	Water Reactive Substances

Figure 670-A-1. Hazardous Materials Compatibility Chart (Sheet 1 of 2)

		<b>REACTIVITY CODE</b>		<b>CONSEQUENCES</b>	
		<b>H</b>		HEAT GENERATION	
		<b>F</b>		FIRE	
		<b>G</b>		INNOCUOUS AND NON-FLAMMABLE GAS GENERATION	
		<b>GT</b>		TOXIC GAS GENERATION	
		<b>GF</b>		FLAMMABLE GAS GENERATION	
		<b>E</b>		EXPLOSION	
		<b>P</b>		VIOLENT POLYMERIZATION	
		<b>S</b>		SOLUBILIZATION OF TOXIC SUBSTANCES	
		<b>U</b>		MAY BE HAZARDOUS BUT UNKNOWN	
		<b>H F GT</b>		HEAT GENERATION FIRE AND TOXIC GAS GENERATION	
16					
	17				
		18			
			19		
				20	
	H	GF	GF	GF	21
	H	GF	H	GF	
	H	F			22
					23
					24
	GF	U	GF	GF	25
				H	GF
				H	GF
				H	GF
					27
					28
					29
	H	H	E	H	GF
		H	GF	H	GF
					30
					31
					32
					33
					34
					101
					102
					103
					104
					105
					106
					107

DO NOT MIX WITH ANY CHEMICAL OR WASTE MATERIALS EXTREMELY REACTIVE

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	101	102	103	104	105	106	107
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Figure 670-A-1. Hazardous Materials Compatibility Chart (Sheet 2 of 2)

**APPENDIX B.****PROCEDURE TO OBTAIN PROTECTED STOWAGE FOR IN-USE FLAMMABLE AND COMBUSTIBLE MATERIAL ABOARD SHIP****670-B.1**

The type, quantity, and location of in-use flammable and combustible material stowage facilities aboard ship are determined and authorized by the Naval Sea Systems Command (NAVSEA) through Ship Alterations (SHIPALT's). For ships in need of protected stowage for in-use flammable and combustible materials, the following procedure shall be utilized:

1. Contact the NAVSEA Ship Logistics Manager (SLM) responsible for your ship type to determine if a SHIPALT to install in-use stowage facilities has been issued for your ship class, and if so, if it has been programmed for installation aboard your ship. NAVSEA SLM's are identified as follows:
  - a SEA 912 - Aircraft Carriers
  - b SEA 913 - Surface Combatants (excluding gas turbine ships)
  - c SEA 914 - Gas Turbine ships
  - d SEA 921 - Submarines
  - e SEA 931 - Auxiliary/Amphibious/Minecraft ships
2. If no SHIPALT has been issued, contact the NAVSEA Flammable Liquids Program Manager, SEA 55W15 (A/V 222-1890), to determine if sufficient surveys have been received from other ships of the same class. If sufficient surveys have been received, no further action is required pending SHIPALT development by SEA 55W15.
3. If sufficient surveys have not been received, perform a ship-wide survey of in-use flammable and combustible materials using the reporting format shown in [Figure 670-B-1](#) and the following instructions:
  - a Identify the compartment number and title as shown on the compartment label plate or Booklet of General Plans.
  - b Include the department and division responsible for the compartment and, if applicable, any other departments or divisions supported by stocks of flammable and combustible materials stowed within that compartment.
  - c Identify National Stock Numbers (NSN's) when available. For non-NSN items (such as open purchase), or when NSN is not legible, provide description and other identifying information such as military or federal specification, physical composition, and flashpoint.
  - d Identify the unit of issue (can, box, case), container size (12 ounce, pint, quart, gallon), and the quantity stowed within the space. Include flammable and combustible materials required on a regular basis which are not presently stowed within the compartment. Exclude items presently on hand but used for a one-time special project.
  - e Include all pressurized dispensers (aerosols), regardless of contents, and identify them as aerosol in the remarks column.
  - f State any qualifying remarks such as justification for stowing more than one container of any item or for retention of paint.
  - g Identify on the survey sheets or in the forwarding letter all lockers, cabinets, issue rooms, and ready service storerooms presently installed. Include the following information for each cabinet:
    - (1) Manufacturer and model number
    - (2) Capacity in gallons, or dimensions
    - (3) Type of doors (self-closing, self-latching)
    - (4) Laboratory approval (such as Factory Mutual); if none, so state
    - (5) Compartment number and title where installed.
  - h Enclose the survey sheets with a SHIPALT request to provide for protected stowage for in-use flammable and combustible materials, and forward through your chain of command to:

Commander, Naval Sea Systems Command  
SEA (enter appropriate SLM code)  
Department of the Navy  
Washington, D.C. 20362-5101

- i Send a blind copy of the request and forwarding letter, with copies of the survey sheets, to the NAVSEA Flammable Liquids Program Manager, SEA 55W15.

[illegible]

## REAR SECTION

### NOTE

TECHNICAL MANUAL DEFICIENCY/EVALUATION EVALUATION  
REPORT (TMDER) Forms can be found at the bottom of the CD list of books.  
Click on the TMDER form to display the form.

